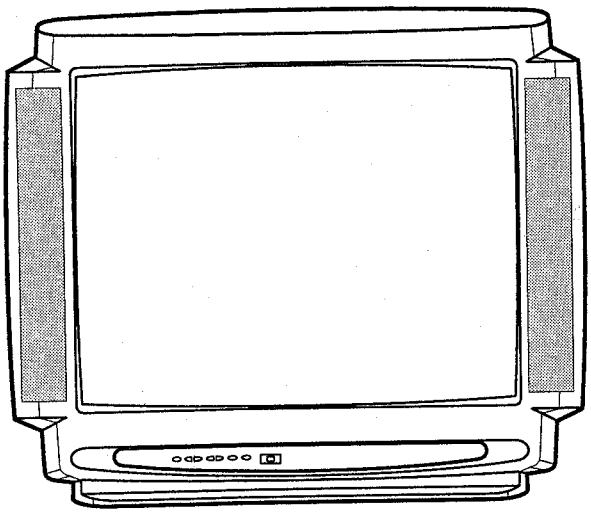
ORDER NO. MTC9506611A1
B5

Service Manual

Color Television



All Models

Panasonic Models	Chassis
CT–27G30T	AMEDP246
CT–27G30CT	AMEDP246
CT–27G30UT	AMEDP246
CT–31G30T	ANEDP252
CT–31G30UT	ANEDP252

Main Manual (NA3D)

NOTE: ***Model CT–27G30UT is identical to CT–27G30T and model CT–31G30UT is identical to CT–31G30T, except for the magnetic field used in the factory to adjust purity and convergence for different markets.***

The service technician is required to read and follow the "Safety Precautions" and "Important Safety Notice" in this manual.

"WARNING! This Service Manual is designed for experienced repair technicians only and is not designed for use by the general public. It does not contain warnings or cautions to advise non–technical individuals of potential dangers in attempting to service a product. **Products powered by electricity should be serviced or repaired only by experienced professional technicians.** Any attempt to service or repair the product or products dealt with in this Service Manual by anyone else could result in serious injury or death."

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Important Safety Notice

There are special components used in this television set which are important for safety. These parts are identified on the schematic diagram by the symbol ⚠ and printed in **BOLD TYPE** on the replacement parts list. It is essential that these critical parts should be replaced with manufacturer's specified parts to prevent X–RADIATION, shock, fire or other hazards. Do not modify the original design without the permission of manufacturer.

Safety Precautions

General Guidelines

An ISOLATION TRANSFORMER should always be used during the servicing of a receiver whose chassis is not isolated from the AC power line. Use a transformer of adequate power rating as this protects the technician from accidents resulting in personal injury from electrical shocks. It will also protect the receiver and its components from being damaged by accidental shorts of the circuitry that may be inadvertently introduced during the service operation.

When servicing observe the original lead dress, especially in the high voltage circuit. In case of a short circuit, replace every part which has overheated.

Always REPLACE PROTECTIVE DEVICES, such as fishpaper, isolation resistors and capacitors and shields after working on the receiver. Use only manufacturers recommended rating for fuses, circuit breakers, etc.

High potentials are present when this set is operating. Operation of the set without the rear cover involves the danger of electric shock from the set's power supply. Servicing should not be attempted by anyone who is not thoroughly familiar with the precautions necessary when working on high–voltage equipment.

Extreme care should be used in HANDLING THE PICTURE TUBE. Rough handling may cause it to implode due to atmospheric pressure (14.7 lbs per sq. in.). Do not nick or scratch the glass or subject it to any undue pressure in removal or installation. When handling, use safety goggles and heavy gloves for protection. Discharge picture tube by shorting the anode connection to chassis ground (not cabinet or other mounting parts). When discharging, go from cold ground (i.e. dag ground lead) to anode with a well insulated piece of wire.

Avoid prolonged exposure at close range to unshielded areas of the picture tube. Possible danger of personal injury from unnecessary exposure to X–ray radiation may result.

The TEST PICTURE TUBE used for servicing the chassis at the bench should incorporate a safety glass and magnetic shield. The safety glass affords shielding from the tube viewing area against X–ray radiation as well as implosion protection. The magnetic shield limits X–ray radiation around the bell of the picture tube in addition to restricting magnetic effects. When using a picture tube test jig for service, ensure that jig is capable of handling 31kV without causing X–radiation.

BEFORE RETURNING A SERVICED RECEIVER **(of any type)** TO THE OWNER, the service technician must thoroughly test the unit to be certain that it is completely safe to operate without danger of electrical shock. DO NOT USE A LINE ISOLATION TRANSFORMER WHEN MAKING THIS TEST.

Leakage Current Cold Check

Unplug the AC cord and connect a jumper between the two plug prongs.

Measure the resistance between the jumpered AC plug and each exposed metallic part such as screw heads, antenna terminals, control shafts, etc. If the exposed metallic part has a return path to the chassis, the reading should be between 240kΩ and 5.2MΩ. When the exposed metal does not have a return path to the chassis, the reading must be infinite.

Leakage Current Hot Check (See Figure)

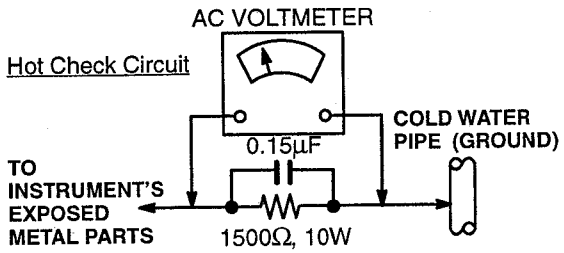
Plug the AC cord directly into the AC outlet. Do not use an isolation transformer during the check.

Connect a 1.5kΩ 10 watt resistor in parallel with a 0.15μF capacitor between each exposed metallic part and ground. Use an earth ground, for example a water pipe.

Using an AC voltmeter with 1000 ohms/volt or more sensitivity, measure the potential across the resistor.

Move the resistor connection to each exposed metallic part and measure the voltage present.

Check that any potential does not exceed 0.75 volt RMS. A leakage current tester (Simpson Model 229, Sencore Model PR57 or equivalent) may be used in the above hot check, in which case any current measure must not exceed 1/2 milliamp. In case any measurement is out of the limits specified, there is a possibility of a shock hazard and the set must be repaired and rechecked before it is returned to the customer.



X–Radiation

WARNING: The potential source of X–radiation in TV sets is the High Voltage section and the picture tube.

NOTE: It is important to use an accurate, periodically calibrated high voltage meter.

Adjust BRIGHTNESS, PICTURE, SHARPNESS and COLOR controls to Minimum.

Measure the High Voltage. The high voltage meter should indicate 29.25kV ±1.25kV. If the upper meter indication is out of tolerance, immediate service and correction is required to insure safe operation and to prevent the possibility of premature component failure.

Horizontal Osc. Disable Circuit Test

This test must be made as a final check before the set is returned to the customer. See HORIZONTAL OSC. DISABLE CIRCUIT PROCEDURE CHECK in this manual.

Specifications

Power Source:	120 volts, 60 Hz, AC
Power Consumption:	2.0 amps Max.
Antenna Terminal Impedance:	(1) UHF/VHF 75Ω input
Channel Capability:	181 Channels (Phase 18M1 Synthesizer)
Off the Air:	VHF 2~13, UHF 14~69
Cable:	125 Channels

INPUTS:

All Models

(2) Video Input Jack:	1V p–p 75Ω, phono jack type
(2 pairs) Audio Input Jack (L & R):	500mV RMS, High impedance–10k
(1) S–Video Input:	Round 4 pin S–Video connector (rear)

OUTPUTS:

Audio Out/Variable:	0~1V, RMS, 10k (30% modulation)
Stereo Output Power:	3.5W x 3.5W (10% Distortion)

FEATURES:

AI Sound:	This feature is used to enhance sound quality through automatic adjustment of Bass and Treble during Speech or Music segments of the audio broadcast. It also regulates the volume between program and commercial audio to maintain a constant sound output level.
Surround Sound:	This feature is used to enhance audio response when listening to stereo broadcasts.
Comb Filter:	Separates video signal from chroma
PIP:	(2 Tuner) Small inset picture of the another TV channel (Second tuner video) or of an External Video Input
Notch Filter:	Minimizes noise on the edges of colored images
Closed Caption Viewing:	Visual depiction of information contained in the audio portion of a television program.
Remote Control:	2 Tuner Easicon Universal Infra–red system **Panasonic** (EUR501232)

PICTURE TUBE:

27" diagonal (Viewing area) 100 degree deflection **M68LGL061X**

31" diagonal (Viewing area) 110 degree deflection **M78JUA069X**

Anode Voltage: 30.5kV Max. (zero beam) 29.25kV (±1.25kV)

DIMENSIONS:

CT–27G30T; CT–27G30CT; CT–27G30UT

Height – 23–15/32" (596mm)
Width – 30–7/32" (768mm)
Depth – 20–13/16" (529mm)
Weight – 80.5 lbs. (36.5 kg)

CT–31G30T; CT–31G30UT

Height – 25–3/4" (654mm)
Width – 34–9/32" (867mm)
Depth – 26–39/64" (676mm)
Weight – 114.5 lbs (51.9 kg)

Specifications are subject to change without notice or obligation. Dimensions and weight are approximate measurements.

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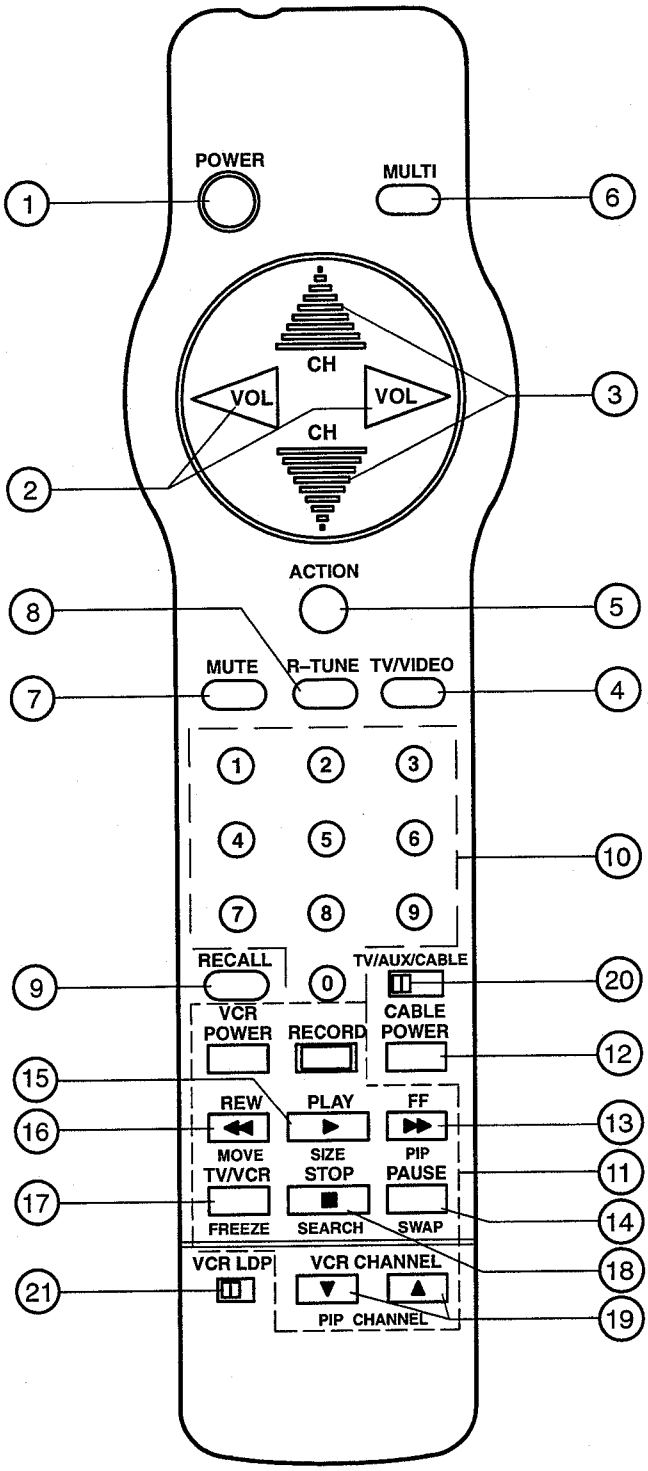
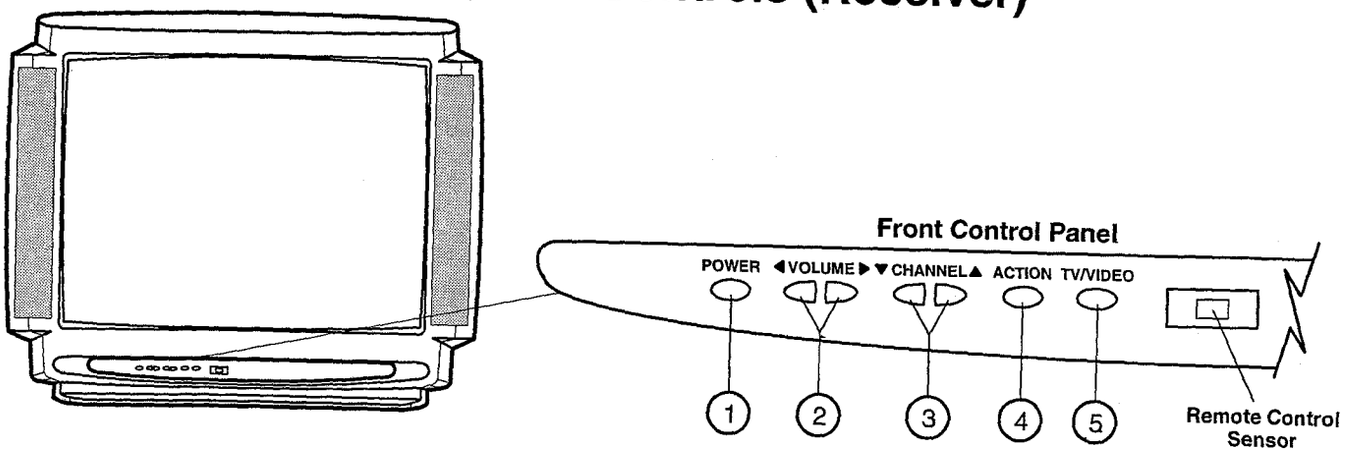
Followed by 5 Large Separate Schematic Sheets With All Schematics, Waveforms, Voltage Charts, Notes, Printed Wiring Boards & Audio/Video Block Diagrams.

Location of Controls (Remote Control)



Location of Controls (Receiver)



Quick Reference Control Operation (Remote & Receiver)

(1) **Power Button** – Press to turn ON or OFF.

(2) **Volume Buttons** – Press to adjust Sound Level. Press to adjust Audio Menus, Video Menus and select operating features when menus are displayed.

(3) **Channel Buttons** – Press to select programmed channels. Press to highlight desired features when menus are displayed. Also used to select Cable Converter box channels after programming Remote Control Infra–red codes (the TV/AUX/CABLE switch must be set in CABLE position).

(4) **TV/Video Button** – Press to select TV or one of two Video Inputs, for the Main Picture or the PIP frame (when PIP frame is displayed).

(5) **Action Button** – Press to display Main Menu and access or exit On Screen feature and Adjustment Menus.

(6) **Multi Button** – Programmable to operate up to six Remote Function buttons.

(7) **Mute Button** – Press to mute sound. A second press returns sound.

(8) **R–Tune (Rapid Tune) Button** – Press to switch between two channels.

(9) **Recall Button** – Press to display Time, status of Sleep Timer, Channel, Video Mode, Channel Caption (Station Identifier) and Audio Mode.

(10) **Keyboard "0 through 9" Buttons** – Press desired channel number to access any channel.

(11) **VCR Function Buttons** – Programmable to operate many brands of VCRs.

(12) **Cable Power Button** – Programmable to operate selected CATV converter boxes.

(13) **PIP (Picture In Picture) Button** – Press to display the PIP frame, press again to remove PIP frame.

(14) **Swap Button** – Press to interchange PIP frame with Main Picture (when the PIP frame is displayed).

(15) **Size Button** – Press to select size of PIP frame (when the PIP frame is displayed).

(16) **Move Button** – Press to position PIP frame to any corner of the Main Picture (when PIP frame is displayed).

(17) **Freeze Button** – Press to stop action in the Main Picture or PIP frame (when the PIP frame is displayed).

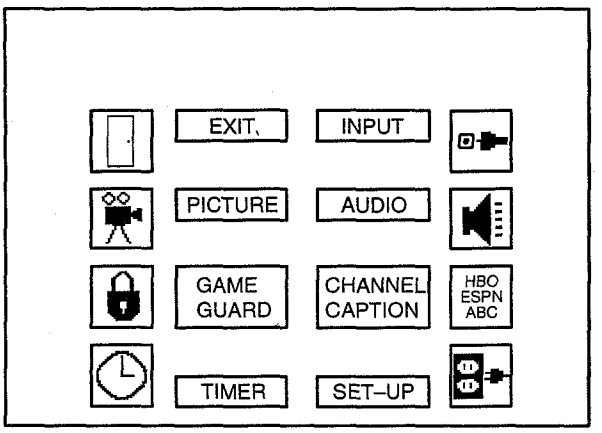
(18) **Search Button** – Press the SEARCH button to automatically scan channels which are programmed into memory. Press the SEARCH button again to delete Search frame.

(19) **PIP Channel Buttons** – When the PIP frame is displayed, press the PIP Channel (CH) UP button to select the next higher programmed channel in the PIP frame. Press the Channel (CH) DOWN button to select the next lower programmed channel in the PIP frame.

(20) **TV/AUX/CABLE Switch** – This switch is used to select the proper mode when programming Remote Control Infra red codes or operating the TV or external equipment (VCR, LDP or Cable TV Converter box).

(21) **VCR/LDP Switch** – This switch is used to select the proper mode when the TV/AUX/CABLE switch is in the AUX position to program the Remote Control Infra red codes or operate the auxiliary equipment (VCR, LDP).

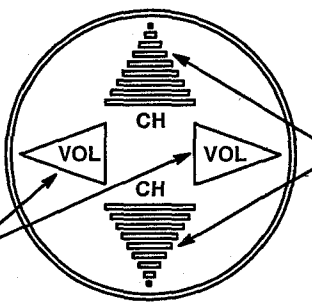
Main Menu (Icons)



Located On Remote Control

ACTION

Displays and Exits Menus



Selects Desired Feature When Menu is Displayed

Selects or Adjusts Features When Menu is Displayed

1. Press the ACTION button to display the Main Menu with Icons.
2. Press the CH UP or DOWN and the VOL LEFT or RIGHT buttons to select the desired Icon when the Main Menu is displayed (selected Icon will be indicated in Red).
3. Press the VOL buttons for left and right movement and the CH buttons for up or down movement.
4. To exit the Main Menu first select the EXIT Icon, then press the ACTION button.

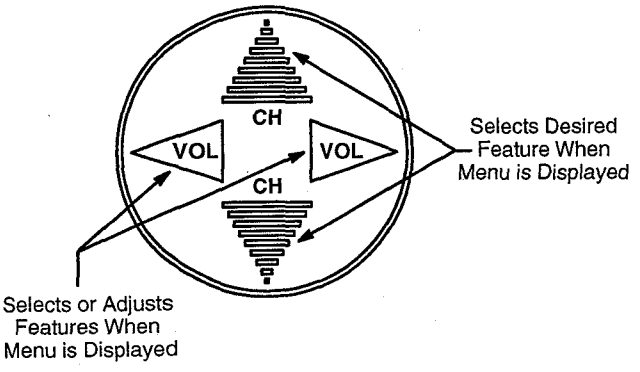
Feature Operation

Input Select

- Main Picture Input Selection
- PIP (Picture in Picture) Input Selection

Displays and Exits Menus

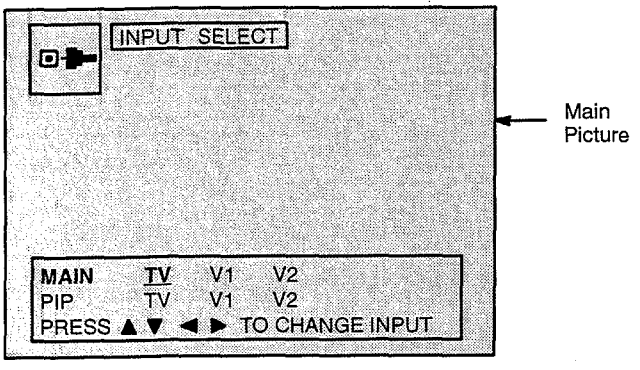
Located On Remote Control



Main (Picture) Input Selection

This feature is used to select TV Mode Operation or one of two Video Inputs for the Main Picture. (Used with optional accessory Video equipment.)

1. Press the ACTION button to display the Main Menu.
2. Press the VOL RIGHT button to select the Input Icon.
3. Press the ACTION button to display the Input Select Menu.



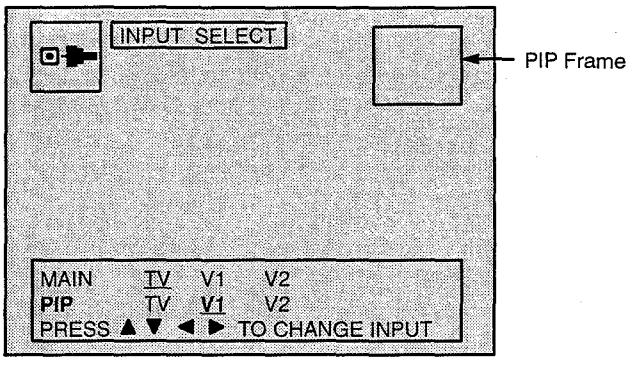
4. Press the CH UP or DOWN button to select "MAIN".
5. Press the VOL LEFT or RIGHT button to select TV or Video on 27" models (TV, V1(Video 1) or V2 (Video 2) on 31" models). The selected mode will be underlined.
6. Press the ACTION button twice to exit the Input Select Menu.

PIP Input Selection

This feature is used to select TV Mode Operation or one of two Video Inputs for the PIP (Picture in Picture) frame. (Used with **second tuner** or optional accessory Video equipment.)

1. Press the ACTION button to display the Main Menu.
2. Press the VOL RIGHT button to select the Input Icon.
3. Press the ACTION button to display the Input Select Menu.
4. Press the CH UP or DOWN button to select "PIP" (the PIP frame will appear in the top right corner).
5. Press the VOL LEFT or RIGHT button to select TV or Video on 27" models (TV, V1(Video 1) or V2 (Video 2) on 31" models). The selected mode will be underlined.
6. Press the ACTION button twice to exit the Input Select Menu.

NOTE: The PIP frame will remain on screen, if desired press the PIP button to delete PIP frame.



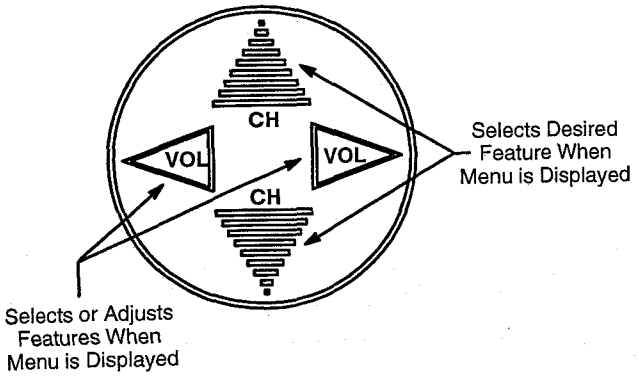
Helpful Hints:

The Game Guard feature must be deactivated before selecting Video Input for Main picture or PIP frame.

Game Guard

Displays and Exits Menus

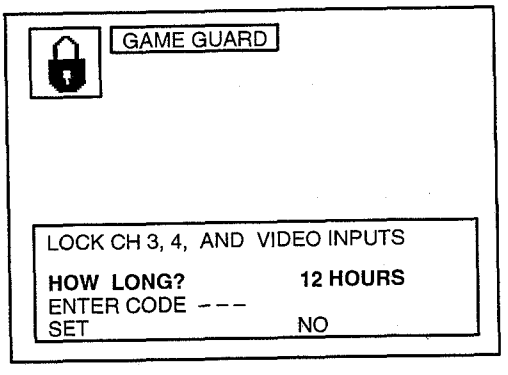
Located On Remote Control



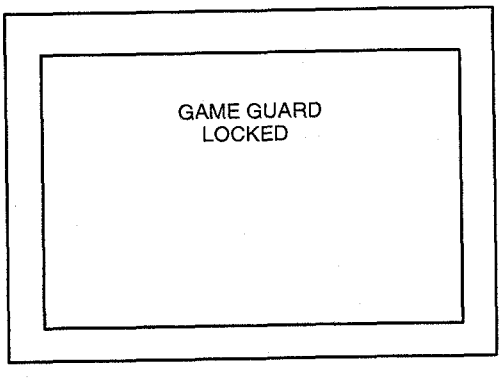
Game Guard (Lockout) – Prevents video games and other video sources from being viewed. Channel 3, 4 and all video inputs are locked out for 12, 24 or 48 hours.

NOTE: Be sure to understand this feature before attempting its use. **Use a code that you will easily remember.**

1. Press the ACTION button to display the Main Menu.
2. Press the CH DOWN button to select the Game Guard Icon.
3. Press the ACTION button to display the Game Guard Menu.



4. Press the VOL RIGHT button to select the desired hours (12, 24 or 48) for Game Guard (Lockout) to be activated.
5. Press the CH DOWN button to select "ENTER CODE". Then enter a 3 digit code with the Remote Control Keyboard.
   Important Note: Use a code you can easily remember.
6. Press the VOL LEFT or RIGHT button after entering three digit code. "Game Guard Locked" will display On Screen.



Game Guard Activated

Game Guard (Unlock)

To unlock the Game Guard feature, repeat steps 1 through 3. Enter the same 3 digit code previously used in step 5 with Remote Control Keyboard.

Serviceman Note: When the code is forgotten press "ACTION" & "POWER" buttons simultaneously for more than 1.5 seconds to cancel feature.

Disassembly for Service

Back Cover

Remove all screws indicated by ◀ on back of set.

1. 5 screws (6 on some models) around perimeter of cabinet.
2. 1 screw (2 on some models) by A/V jacks.
3. 1 screw on AC line cord cover.
4. 1 screw on Flyback Transformer support.

A–Board–Main Chassis

1. Push down on the securing plastic clips (in some sets) and slide chassis completely out. **NOTE:** Some tie–wraps securing wire dressings may have to be unfastened for chassis removal.
2. Stand chassis on it's edge. Now underside is completely accessible for component removal.

C–Board–CRT Output

1. Plugs into socket on CRT neck.

E–Board–Stereo/SAP Decoder

1. Is soldered into the main chassis (A–Board) at A21 and A22 connectors.

Keyboard Push Button Assembly

1. The Keyboard push button assembly is fastened to the escutcheon with 1 screw.

R–Board Remote Receiver

1. Secured to cabinet escutcheon by plastic clips. Use small screwdriver to gently lift clips and pull board out.

S–Board – Second Tuner (PIP)

1. Mounted in cabinet next to to Y–Board.

X–Board A/V 1&2, TV Switching, VAO AI Sound, Surround Sound, S–Video and Comb Filter

1. Plugs into main chassis A1, A2 and A3 sockets.
2. Release connector lock tabs and pull board upwards.
   Note: a small screwdriver or equivalent must be used to release the connector lock tabs.

Y–Board – PIP Processing

1. The Y–Board plugs into the A–Board's A31 and A32 connectors.
2. Release connector lock tabs and pull board upwards.
   Note: a small screwdriver or equivalent must be used to release the connector lock tabs.

Z–Board (31" Models only) –Pincushion Correction

1. Plugs into Main A–Board) A7 socket.

Disassembly for CRT Replacement

Disassembly

1. Discharge CRT as instructed in Safety Precautions.
2. Disconnect CRT 2nd anode button.
3. Remove C–Board from CRT base and unplug C10 (black wire–CRT dag ground) from board
4. Disconnect plugs A51, SP, DY & Degaussing coil from A– Board.
5. Slide main chassis assembly completely out with CRT Board attached.

CRT Replacement

1. Perform DISASSEMBLY FOR CRT REPLACEMENT procedure.
2. Insure CRT H.V. anode button is discharged before handling CRT. See SAFETY PRECAUTIONS on handling the picture tube.
3. Remove components on CRT neck and place cabinet face down on a soft pad.
4. Note original locations and mounting of degaussing coil and dag ground assembly to insure proper reinstallation on the replacement CRT.
5. To remove degaussing coil:
   • Release degaussing coil from plastic clampers.
   • Remove the plastic clampers from each CRT mounting stud.
   • Retain plastic clampers for reuse on replacement CRT.
6. Remove the CY and DY from CRT neck.
7. Remove mounting hardware from each CRT mounting stud and remove CRT with dag ground braid attached.
8. To remove dag ground braid:
   • Unhook coil springs from lower CRT corner brackets. Release braid ends from upper left corner bracket (27" models only) and upper right corner bracket (31" models only).
9. Mount dag ground braid on replacement CRT.
10. Remove the AR coat protection sheet before mounting the replacement CRT in the cabinet.
11. Install replacement CRT into cabinet.
12. Install plastic clampers (step 5) on each CRT mounting stud and position degaussing coil as noted from original (step 4).

NOTE: Use tape to temporarily secure the degaussing coil to the CRT.

13. Replace components on CRT neck and reinstall chassis into cabinet. Make sure all ground wires and circuit board plugs are properly connected.
14. Ensure all wires are secure before reattaching the cabinet back.

Purity and Convergence Procedure

Adjustment should be necessary only if the CRT or deflection yoke is replaced or if someone has disturbed the setting. The complete procedure consists of:

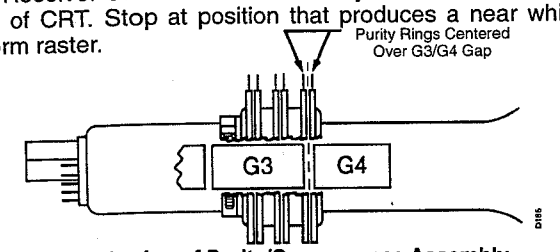
1. Initial static convergence
2. Setting purity
3. Final static convergence

When CRT or Yoke is Replaced

Place the yoke on the CRT neck (do not tighten clamp).

Position purity/convergence assembly as shown and tighten clamp snugly. Cut hot–melt glue seal on assembly and place like tabs of purity device together at 12 o'clock to reduce its magnetic field effect. Manually degauss CRT.

Turn Receiver ON and slide deflection yoke back and forth on neck of CRT. Stop at position that produces a near white, uniform raster.



Positioning of Purity/Convergence Assembly

Initial Center Static Convergence

Connect dot/crosshatch generator to Receiver and tune in signal. Observe misconvergence at center of screen only.

Adjust 4 pole magnet (center rings): separate tabs and rotate device to converge blue with red.

Adjust 6 pole magnet (rear rings): separate tabs and rotate device to converge blue and red (magenta) with green.
NOTE: Precise convergence at this point is not important.

Purity Adjustment

When in the Serviceman Mode for making electronic adjustments, Press the Remote Control (RECALL) button to enter Purity Check. (See Service Adjustments Electronic Controls.)

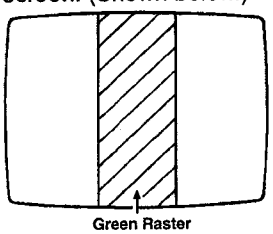
Operate the Receiver for 60 minutes using the first Purity check field (white screen) to stabilize the CRT.

Degauss the Receiver fully by using an external degaussing coil.

Press the Remote Control (RECALL) button again until the Purity Check (green screen) appears.

Loosen the deflection yoke clamp screw and move the deflection yoke back as close to the purity magnet as possible.

Adjust the front rings to set the vertical green raster precisely at the center of the screen. (Shown below.)



Green Raster

Slowly move the deflection yoke forward and adjust for the best overall green screen.

Tighten the deflection yoke clamp screw.

Press the Remote Control (RECALL) button again until the Purity Check (blue screen) and (red screen) appear and observe that good purity is obtained on each respective field.

Press the Remote Control (RECALL) button again until Purity check (white screen) appears. Observe the screen for uniform white. If not, repeat above procedure.

Final Convergence Procedure

NOTE: Before attempting convergence adjustment, vertical size, pincushion and focus adjustments must be completed. Connect a dot pattern generator to the set. The brightness level should be no higher than necessary to obtain a clear pattern.

Converge the red and blue dots at the center of the screen by rotating the 4 pole (R with B) Static Convergence Magnets.

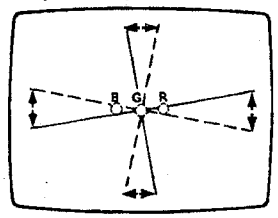
Align the converged red/blue dots with the green dots at the center of the screen by rotating the 6 pole (R/B with G) Static Convergence Magnets. Melt wax with soldering pencil to reseal magnets.

Slightly tilt (do not rotate) the deflection yoke vertically and horizontally to obtain good overall convergence.

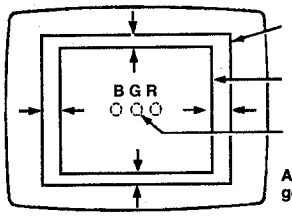
After vertical adjustment of the yoke, insert wedge at 11 o'clock position, then make the horizontal tilt adjustment.

Secure deflection yoke by inserting side two wedges at 3 and 7 o'clock positions.

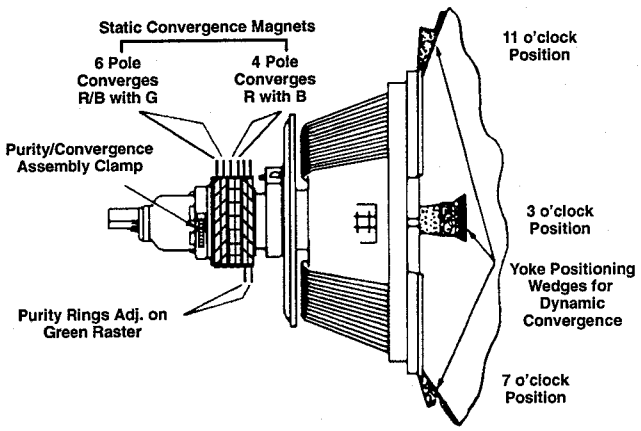
Apply adhesive between tab (thin portion) of wedge and CRT and place tape over tab to secure to CRT.



As the yoke is moved vertically, the rasters produced by the outside guns rotate in opposite directions.


B G R
Raster produced from one of the outside electron beams
Raster from the other outside electron beam
Static convergence magnets are set for center convergence

As the yoke is moved horizontally, one raster gets larger while the other gets smaller


Static Convergence Magnets
6 Pole Converges R/B with G
4 Pole Converges R with B
Purity/Convergence Assembly Clamp
Purity Rings Adj. on Green Raster
11 o'clock Position
3 o'clock Position
Yoke Positioning Wedges for Dynamic Convergence
7 o'clock Position

Permalloy Convergence Corrector Strip (Part No. OFMK014ZZ)

This strip is used in some sets to match the yoke and CRT for optimum convergence. If the yoke or CRT is replaced, the strip may not be required.

First converge the set without the strip and observe the corners.

If correction is needed:

1. Place strip between CRT and yoke, in quadrant needing correction. Slowly move it around for desired results.
2. Press adhesive tightly to the CRT and secure with tape.

Service Notes

IMPORTANT: To protect against possible damage to solid state devices due to arcing or static discharge, make certain all ground wires and CRT DAG wire are securely connected.

CAUTION: The power supply circuit is above earth ground and the chassis cannot be polarized. Use an isolation transformer when servicing to avoid damage to test equipment or chassis. Connect test equipment to correct ground (⏚) or (⏚) when servicing or incorrect readings will occur.

WARNING: This Receiver has been designed to meet or exceed applicable safety and X-radiation protection as specified by government agencies and independent testing laboratories.

To maintain original product safety design standards relative to X-radiation and shock and fire hazard, the parts indicated by the symbol ⚠ on the schematic must be replaced with identical replacement parts. Order parts from the manufacturer's parts center using numbers shown in this service manual or give complete chassis number and part reference number.

For optimum performance and reliability, all other parts should be replaced with components having identical specifications.

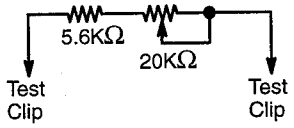
Horiz Hold Down Circuit

This chassis employs a special circuit to protect against excessive high voltage and beam current. If for any reason the high voltage and beam current exceed a predetermined amount, this circuit operates and detunes the horizontal oscillator. As a result, the horizontal looses sync and if high voltage or beam current varies significantly the video is interrupted to blank the screen. This limits high voltage.

The Horizontal Hold Down protection circuit is not adjustable. However, if components indicated by the symbol ⚠ on the schematic in either the horizontal sweep system or the Hold Down protection circuit itself are changed the operation of the circuit should be checked using the following procedure.

Equipment needed:

1. Signal Generator with crosshatch pattern.
2. Digital Voltage Meter
3. High Voltage Meter (0V–50KV)
4. Variac and Isolation Transformer
5. HHS test jig made with 20KΩ potentiometer and 5.6KΩ resistor with test clips as shown.



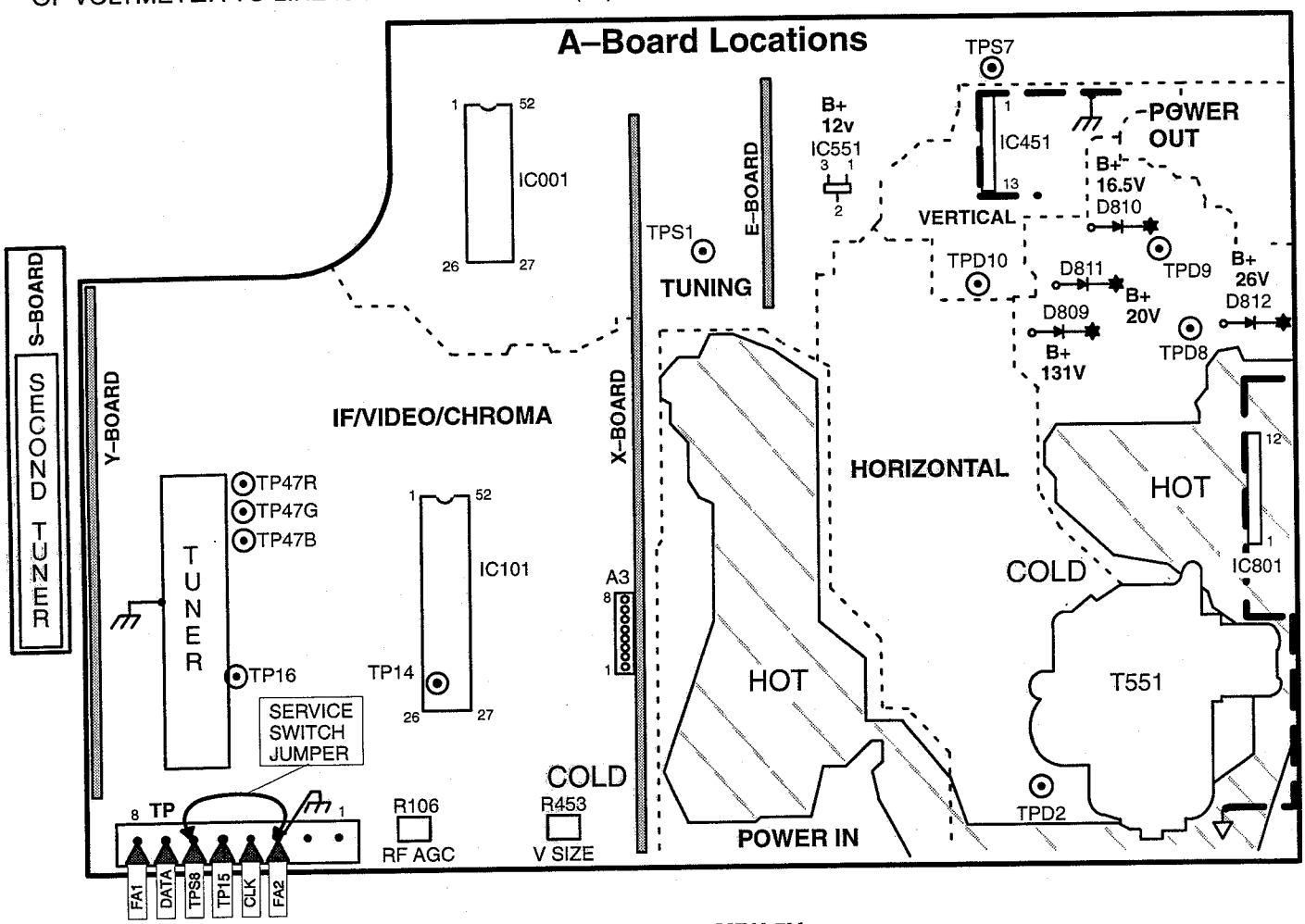
Preparation

1. Connect Receiver through variac and isolation transformer to AC line. Set variac to 120V AC.
2. Connect signal generator with crosshatch pattern.
3. Connect High Voltage Meter to 2nd anode under rubber cup on CRT.
4. Turn Receiver ON and confirm that horizontal is in sync.
5. Use the Picture Icon Menu to adjust Brightness and Picture video adjustments for a DVM reading between 0.5V and 1V. (This condition exists when the crosshatch pattern is just viewable on the screen.)
6. Turn Receiver OFF. Connect the HHS test jig to IC801 Pin 1 and Pin 2. Test jig potentiometer should be set to maximum resistance.
7. Turn Receiver ON. Slowly reduce the potentiometer resistance until the horizontal just begins to pull out of sync.
8. Observe the High Voltage meter. HIGH VOLTAGE should read less then 34.8KV at point where horizontal sync is lost.
9. Turn Receiver OFF. Disconnect test jig and meter leads from chassis.

CAUTION:
If High Voltage is not within the specified limit, the cause must be determined before the Receiver is returned to the owner.

Service Adjustment Procedures

ALL SERVICE ADJUSTMENTS ARE FACTORY PRESET AND SHOULD NOT REQUIRE ADJUSTMENT UNLESS CONTROL AND/OR ASSOCIATED COMPONENTS ARE REPLACED.
NOTE: CONNECT MINUS LEAD OF VOLTMETER TO CORRECT GROUND FOR CIRCUIT BEING CHECKED. WHEN NECESSARY TO USE A LINE OPERATED GROUND, THE GROUND INDICATION (⏚) WILL BE INDICATED. FOR THIS GROUND, USE IC801 HEAT SINK. FOR ALL OTHER CIRCUITS, CONNECT MINUS LEAD OF VOLTMETER TO LINE ISOLATED GROUND (⏚)TUNER SHIELD, IC451 HEAT SINK OR FA2.



131.0V B+ Voltage Confirmation

1. Set BRIGHT and PICTURE by using Picture Menu to Minimum.
2. Connect a DVM between cathode of D809 and cold ground (⏚) FA2 (TP Pin3).
3. Confirm that B+ voltage is 131.0V ±1.0V. This voltage supplies B+ to Horizontal Output & Flyback circuits.

Source Voltage Chart

120V AC line input. BRIGHT and PICTURE of Picture Menu adjusted to Minimum. Use cold ground (⏚) for minus lead of DVM.

Pin 3 of IC551	+9.0V ±0.5V
Cathode of D810(TPD9)	+16.5V ±2.0V
Cathode of D811(TPD10)	+20.0V ±2.0V
Cathode of D812(TPD8)	+26.0V ±2.0V
Cathode of D554	+220V ±15V

Adjust Picture menu for normalized video adjustments.

B+ 5V Source Voltages

Volatile 5V:
Cathode D557 = Tuner BP, IC101 (B+ V_{cc}), RF AGC (R106)

MPU 5V:
Emitter Q002 = IC001(V_{DD})

Standby 5V:
Cathode D006 = Keyboard, IC001 (Key in 1, I^2C EE-PROM (IC002), Remote Receiver (some models)

B+ 9V Source Voltage

Cathode D560 = IC101 (B+ V_{cc}) (HOLD DOWN) (AFC OUT),Q306 – Q305 (Video), Q307 (Closed Caption E.F.), IC001 (Audio Control B/T/B in some models).

B+ 12V (Stand–by)

Cathode D001 = RL001 (on–off relay), Q002 (+5V Reg), IC101 (Horiz. Vcc).

High Voltage Check

1. Select an active TV channel and confirm that horizontal is in sync.
2. Adjust Brightness and Picture using Picture Icon menu so video just disappears
3. Confirm B+ 131V is within limit.
4. Using a calibrated high voltage meter confirm that High Voltage is 29.25kV ±1.25kV.

Serviceman Mode (Electronic Controls)

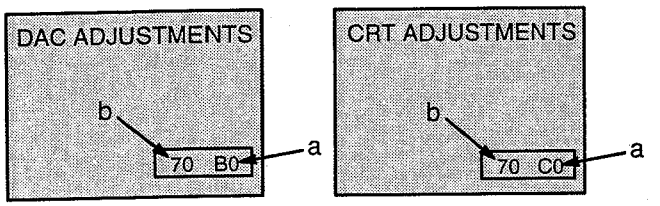
This chassis has new electronic technology using the I^2C Bus Concept. The system usually performs as a control function and replaces many of the required mechanical controls. Instead of adjusting various mechanical controls individually, many of the control functions are now performed electronically by using "On Screen Menu". (The Serviceman Adjustment Mode.)

NOTE: It is suggested that a serviceman read all the way through and understand the following procedure for Entering/Exiting the Serviceman Adjustment Mode; then proceed to follow the instructions working with the Receiver. After a person is familiar with this adjustment procedure, use the Instructional Flow Chart for Serviceman Mode as a quick guide.

Entering Serviceman Mode:

1. While the Receiver is ON and operating in Normal Mode, momentarily short test point FA1 (TP pin 8) to cold ground (⏚) FA2 (TP pin 3).
   "The Receiver enters the Aging Mode".
   (The VOLUME UP/DOWN will adjust rapidly.)
2. **Press** ACTION button and VOLUME UP button on Receiver Control Panel simultaneously.
   "The Receiver enters the Servicemans Mode".
   (The VOLUME UP/DOWN will adjust normally.)
   (All customer controls are set to a nominal level.)
3. **Press** the POWER button on the Remote Control to select one of four Serviceman Adjustment Modes.
   - B = Serviceman DAC ADJUSTMENTS
   - C = Serviceman CRT ADJUSTMENTS
   - S = Factory Adjustments for PIP
   - Normal TV = Normal operation of channel ▲▼ and volume ▲▼

   Note: Sb is used for MPU clock–offset

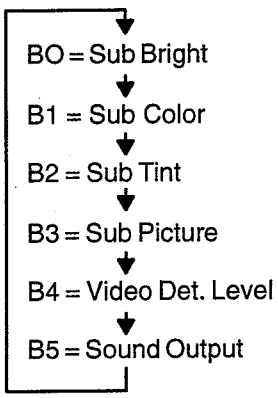


An Address Menu appears in the bottom right hand corner of the screen.

For DAC Adjustments:

a.) Press
CHANNEL UP/DOWN or DIAMOND UP/DOWN on the Remote Control to select any of 6 Service Adjustment Addresses.

Important Note: Write down the original value (b in detail) for each address adjustment before adjusting anything. It is easy to adjust the wrong item.



b.) Press
VOLUME UP/DOWN or DIAMOND RIGHT/LEFT on the Remote Control to adjust the level of the selected Service Adjustment.

Adjustment Range and Default level values for Service Adj.

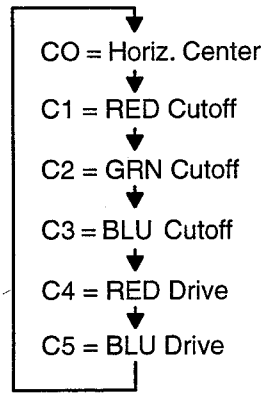
Service Adjustment	Adj Range	Default Level
Sub Bright (BO)	0 ~ 127	97
Sub Color (B1)	0 ~ 63	33
Sub Tint (B2)	0 ~ 63	33
Sub Picture (B3)	0 ~ 63	21
Video Detector Level (B4)	0 ~ 15	8
Sound Out (B5)	0 ~ 15	8

Press the POWER button on the Remote Control to select Serviceman CRT Adjustment Mode.

For CRT Adjustments:

a.) Press
CHANNEL UP/DOWN or DIAMOND UP/DOWN on the Remote Control to select any of 6 Service Adjustments.

Important Note: Write down the original value (b in detail) for each address adjustment before adjusting anything. It is easy to adjust the wrong item.



b.) Press
VOLUME UP/DOWN or DIAMOND RIGHT/LEFT on the Remote Control to adjust the level of the selected Service Adjustment.

Adjustment Range and Default level values for Service Adj.

CRT Adjustment	Adj Range	Default Level
Horiz Centering (C0)	0 ~ 15	8
RED Cutoff (C1)	*0 ~ 511	128
GRN Cutoff (C2)	*0 ~ 511	128
BLU Cutoff (C3)	*0 ~ 511	128
RED Drive (C4)	0 ~ 255	128
BLU Drive (C5)	0 ~ 255	128

*Adjustment indicated in 2 steps (0 ~ 255) ➡ (H0 ~ H255)

(cont'd.)

Press the Power button on the Remote Control to select the next Serviceman Mode.

Factory Adjustments: S0~Sb

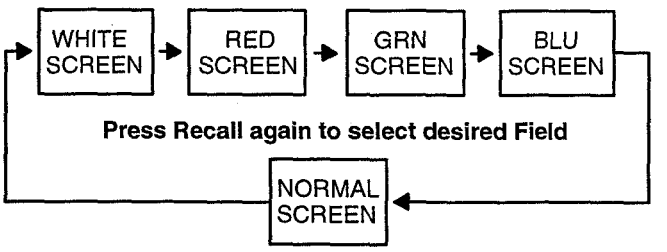
The Factory Adjustments for PIP can be entered but no adjustments should be necessary. These are factory set for normal PIP performance. Write the original value for each address in case one of these adjustments is changed by mistake. Confirm that the values are as shown for default level.

Adjustment Range and Default level values for Service Adj.

Service Adjustment	Default Level
PIP Color (S0)	25
PIP Tint (S1)	55
PIP Sync Level (S2)	04
PIP Upper V–Pos (S3)	229
PIP Lower V–Pos (S4)	111
PIP Left H–Pos (S5)	30
PIP Right H–Pos (S6)	126
Small PIP Upper V–Pos (S7)	229
Small PIP Lower V–Pos (S8)	93
Small PIP Left H–Pos (S9)	30
Small PIP Right H–Pos (Sa)	140
MPU Clock–offset (Sb)	128

To Check Purity:

Press the RECALL button on the Remote Control to enter Purity Field Check Mode.
NOTE: Must be in Serviceman Mode to get color.



IMPORTANT NOTE:
Always Exit Serviceman Mode After Use.

Exit Serviceman Mode:

1. Press ACTION + POWER buttons on receiver simultaneously for approximately 2 seconds.
   "The Receiver exits Serviceman Mode".

The Receiver momentarily shuts off; then comes back on tuned to channel 3 with a preset level of sound.

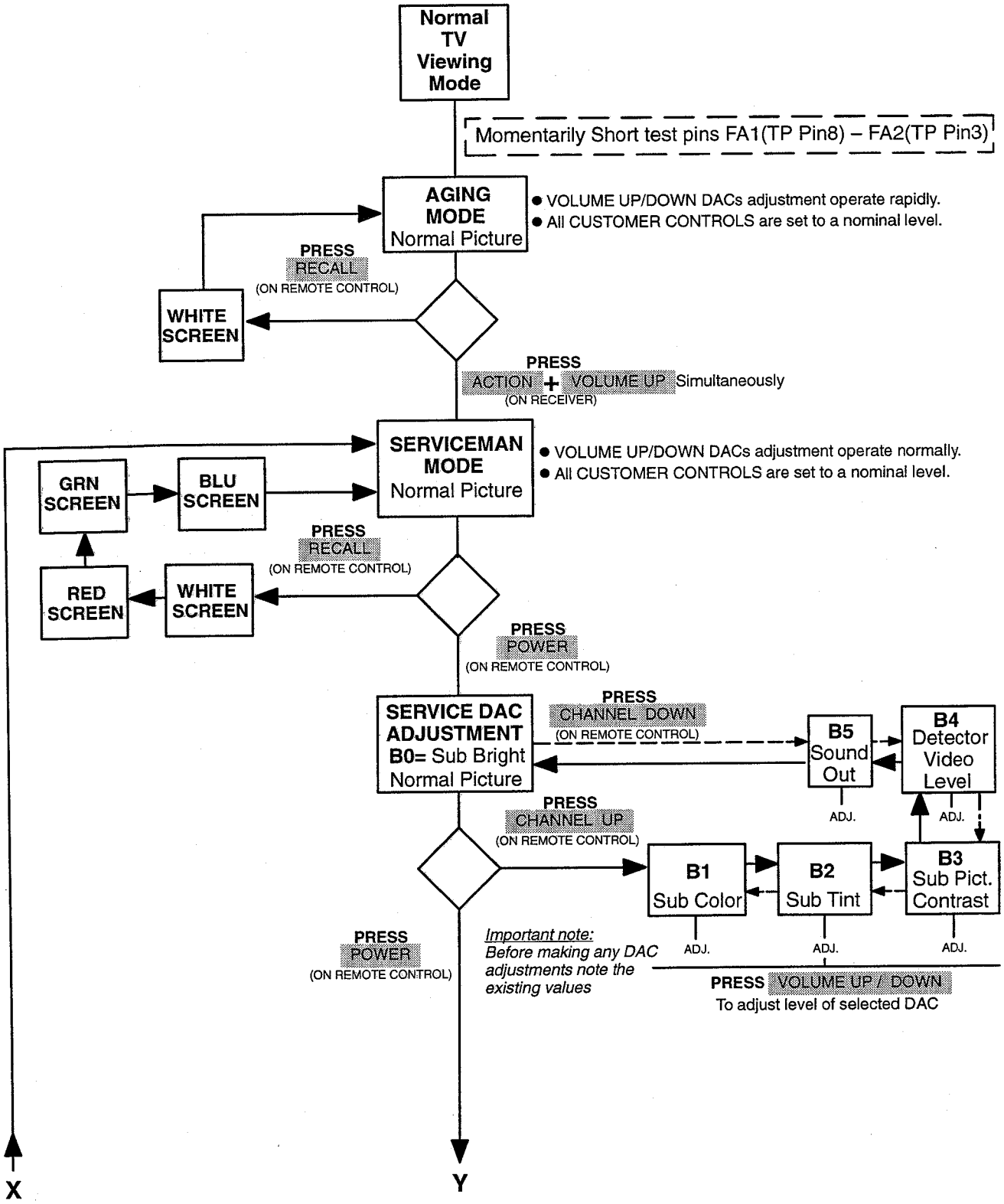
Quick Entry To Serviceman Mode

At times when minor adjustments need to be done to the electronic controls, the method of Entering the Serviceman Mode without removal of the cabinet back is as follows using the Remote Control:

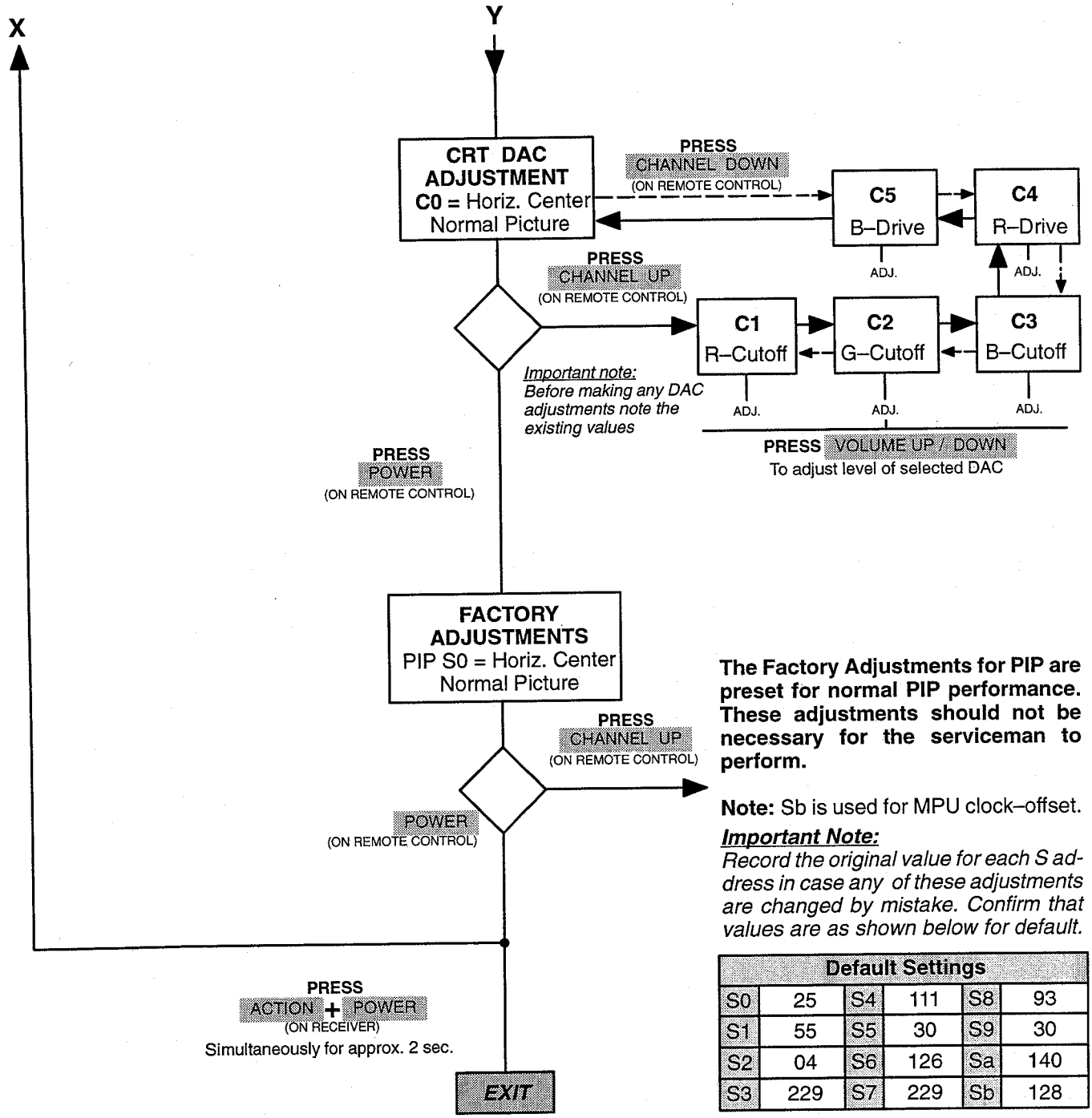
1. Select SET–UP icon and select CABLE mode.
2. Select TIME Icon and set SLEEP timer for 30.
3. Press ACTION button twice to cancel Icon Menus.
   Tune to Channel 124.
   Adjust VOLUME to Minimum (0).
   On Receiver press the VOL ◄ button (decrease).
   Red "CHK" appears in upper corner.

Instructional Flow Chart for Serviceman Mode

Caution: Always EXIT Serviceman Mode after use


Normal TV Viewing Mode
Momentarily Short test pins FA1(TP Pin8) – FA2(TP Pin3)
AGING MODE Normal Picture
● VOLUME UP/DOWN DACs adjustment operate rapidly.
● All CUSTOMER CONTROLS are set to a nominal level.
PRESS RECALL (ON REMOTE CONTROL)
WHITE SCREEN
PRESS ACTION + VOLUME UP Simultaneously (ON RECEIVER)
SERVICEMAN MODE Normal Picture
● VOLUME UP/DOWN DACs adjustment operate normally.
● All CUSTOMER CONTROLS are set to a nominal level.
GRN SCREEN
BLU SCREEN
RED SCREEN
WHITE SCREEN
PRESS RECALL (ON REMOTE CONTROL)
PRESS POWER (ON REMOTE CONTROL)
SERVICE DAC ADJUSTMENT B0= Sub Bright Normal Picture
PRESS CHANNEL DOWN (ON REMOTE CONTROL)
B5 Sound Out
B4 Detector Video Level
ADJ.
ADJ.
PRESS CHANNEL UP (ON REMOTE CONTROL)
B1 Sub Color
B2 Sub Tint
B3 Sub Pict. Contrast
ADJ.
ADJ.
ADJ.
PRESS POWER (ON REMOTE CONTROL)
Important note:
Before making any DAC adjustments note the existing values
PRESS VOLUME UP / DOWN
To adjust level of selected DAC
X
Y

(cont'd.)



The Factory Adjustments for PIP are preset for normal PIP performance. These adjustments should not be necessary for the serviceman to perform.

Note: Sb is used for MPU clock–offset.

Important Note:
Record the original value for each S address in case any of these adjustments are changed by mistake. Confirm that values are as shown below for default.

Default Settings					
S0	25	S4	111	S8	93
S1	55	S5	30	S9	30
S2	04	S6	126	Sa	140
S3	229	S7	229	Sb	128

Receiver shuts OFF; then turns ON, TUNED TO CHANNEL 3 WITH A PRESET LEVEL OF SOUND.

Note: This will also erase any Programmed Channels, Channels Caption data and some other user defined items.

Service Adjustments (Electronic Controls)

Sub–Brightness

Serviceman DAC Adjustment (B0)

Adjustment of this control is important for getting proper operation of customer brightness and picture controls. This adjustment must be made after Sub–Contrast or Color Temperature adjustments are made. **Do not adjust** SCREEN after Sub–Brightness is set.

Preparation:

1. Connect a color bar signal with 100 IRE white and 7.5 IRE black. (Switch Color "OFF" on the generator.) Operate television for a minimum of 10 minutes prior to the adjustment.

Procedure:

1. In Serviceman Mode for making electronic adjustments, select DAC adjustment (B0) and adjust so the black bar starts to look grey. Then decrease the adjustment to the point where grey turns to black.

Video Detector Level

Serviceman DAC Adjustment (B4)

Preparation:

1. Obtain an NTSC color bar pattern with 100 IRE white and 87.5% modulation.
2. Connect oscilloscope to TP12. Use cold ground for scope connection. Set scope at Horizontal rate (20μs) time base.

Procedure:

1. In Serviceman Mode for making electronic adjustments, select DAC Adjustment (B4) and adjust for 1V from sync tip to white level. See detail.

2. Set SUB–CONTRAST adjustment (DAC adjustment B3).

Sub Contrast

Serviceman DAC Adjustment (B3)

This adjustment is factory set. **Do not adjust** unless repairs are made to associated circuit, the CRT Board or the CRT is replaced.

Preparation:

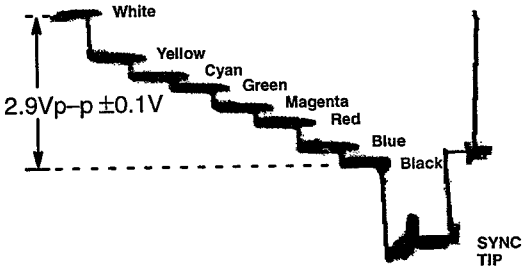
1. Connect a generator pattern with 87.5% modulation, 70% saturated color bar with a 100 IRE white and 7.5 black.

NOTE: The pattern used in this procedure is an EIA color bar pattern with 87.5% modulation with 100 IRE white and 7.5 black. Correlate the information in this procedure to your pattern used.

2. Connect oscilloscope to CRT–Board connector C1–2 (TP35) Set scope horizontal time base to 20μs (horizontal).
3. Connect a jumper from TPD2 to ground (⏚).

Procedure:

1. In the Serviceman Mode for electronic adjustments, select DAC Adjustment (B3) and adjust for 2.9Vp–p ±0.1V from white level to black level on video waveform (see video waveforms detail).



2. Remove jumper (Preparation step 3).

Tint/Color Adjustment

Serviceman DAC Adjustment (B2) (B1)

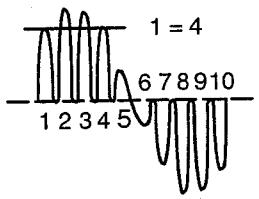
Preparation:

1. Connect a rainbow color bar signal.
2. Connect oscilloscope to TP47R (A–Board) or connector C1 pin 1 (CRT–Board).
3. Connect jumper from TPD2 to GND (⏚).

Procedure:

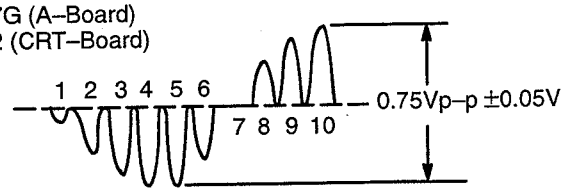
1. In serviceman Mode for making electronic adjustments, select DAC Adjustment (B2) and adjust waveform so peak 1 is the same as peak 4 as shown in the detail.

TP47R (A–Board)
C1–1 (CRT–Board)



2. Connect oscilloscope to TP47G (A–Board) or connector C1 pin 2, TP35 (CRT–Board).
3. Select DAC adjustment (B1) and adjust for peak to peak waveform to be 0.75V p–p ±0.05V.

TP47G (A–Board)
C1–2 (CRT–Board)



4. Remove jumpers (Preparation step 3).

Color Temperature Adjustment (B/W Tracking)

Serviceman DAC Adjust. (C1) (C2) (C3) (C4) (C5)

Minor Touch–Up Method

OBSERVE low and high brightness areas of a B/W picture for proper tracking. Adjust only as required for "good grey scale and warm highlights".

- LOW LIGHT areas – In Serviceman Mode for making electronic adjustments, select cutoff (C1) RED, (C2) GRN, (C3) BLU and adjust picture for grey.
- HIGH LIGHT areas – In Serviceman Mode for making electronic adjustments, select Drive (C4) RED, (C5) BLU and adjust for warm whites.

Complete Adjustment

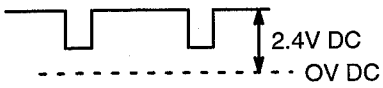
Preparation:

1. Turn Receiver "ON" and allow 10 minutes warm up at high brightness.
2. Apply color bar signal with color "OFF".
3. Turn SCREEN control (part of FBT T551) fully counterclockwise.

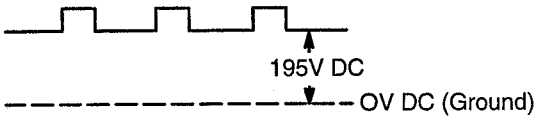
Procedure:

Preset Serviceman DAC's C1, C2 and C3 levels to 128 for best results.

1. Connect oscilloscope to TP35 (CRT–Board).
2. In Serviceman Mode for making electronic adjustment, select Sub Bright (B0).
3. Connect jumper from TPS8 to FA2, (connector TP pin 6 to pin 3).
4. Observe oscilloscope waveform at Horizontal rate and adjust Serviceman Mode Sub Bright DAC (B0) for scanning period of 2.4V above DC ground shown in detail.



5. Remove jumper. (Step 3)
6. Connect scope to GRN Cathode (KG) on CRT–Board.
7. In Serviceman Mode for making electronic adjustments, select GREEN CUTOFF DAC (C2).
8. Connect jumper from TPS8 to FA2, (connector TP pin 6 to pin 3).
9. View scope trace at Horizontal rate and adjust Serviceman Mode DAC (C2) for the scanning period to be 195V above DC ground. (See detail)
10. Remove jumper. (Step 8)
11. Connect scope to RED Cathode (KR) located on CRT board.
12. In Serviceman Mode for making electronic adjustments, select RED CUTOFF DAC (C1), connector TP pin 6 to pin 3).
13. Connect jumper from TPS8 to FA2, (connector TP pin 6 to pin 3).
14. View scope trace and adjust Serviceman Mode DAC (C1) for the scanning period to be 195V above DC ground. (See detail)
15. Remove jumper. (Step 13)
16. Connect scope to BLU Cathode (KB) located on CRT board.
17. In Serviceman Mode for making electronic adjustments, select BLU CUTOFF (C3).
18. Connect jumper from TPS8 to FA2, (connector TP pin 6 to pin 3).
19. View scope trace and adjust Serviceman Mode DAC (C3) for the scanning period to be 195V above DC ground. (See detail)



Adjustment Waveform Detail (Steps 9, 14, 19)

20. Turn Screen Control (part of FBT) slowly clockwise until a color horizontal line appears.
21. With the other two colors Serviceman Mode DAC CUTOFF adjustments (C1) RED, (C2) GRN, (C3) BLU; increase their colors to create a white horizontal line.
22. Remove jumper. (Step 18)
23. Confirm good gray scale by viewing B/W color bar pattern.
24 In Serviceman Mode for making electronic adjustments select DAC DRIVE adjustments (C4) RED, (C5) BLU and adjust for warm white in white color bar of pattern.
25. EXIT Serviceman MODE.
26. Adjust Picture Menu Video Adjustments BRIGHT and PICTURE from low scale to high scale and check Black and White tracking.
27. If correction needed: Re–Enter Serviceman Mode and perform **Minor Touch – Up Method.**
28. Perform SUB BRIGHTNESS adjustment procedure.

Horizontal Centering

Serviceman DAC Adjustment (C0)

Preparation:

1. Connect crosshatch generator.

Procedure:

1. In Serviceman Mode for making electronic adjustments. Select DAC adjustment (C0) and adjust so center of crosshatch pattern is centered on CRT screen.
2. EXIT Serviceman Adjustment Mode.

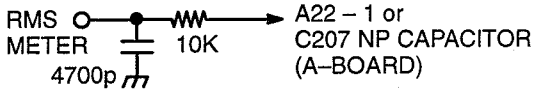
Sound Out

Serviceman DAC Adjustment (B5)

This adjustment is factory set and needs to be performed only when IC002 or IC101 is replaced.

Preparation:

1. Connect 400Hz. 100% modulation (25KHz deviation) signal generator to antenna (70db ±5db, 75Ω open P/S 10db). Generator pre–emphasis must be "OFF" for 1KHz.
2. Connect RMS Meter with filter jig as shown in detail.



Procedure:

1. In Serviceman Mode for making electronic adjustments, select DAC adjustment (B5) and adjust for RMS meter reading of 150mV rms ±7.5mV rms.
2. EXIT Serviceman Adjustment Mode.

MPU Reference Oscillator (Sb)

Preparation:

1. Connect frequency counter from TPS1 (IC001 Pin 25) to cold ground (⏚).

NOTE: Frequency Counter probe capacitance should be 8PF or less.

Procedure:

1. Turn Receiver "OFF" with AC power applied.
2. Measure TPS1 (IC001 pin 25) for the period of the waveform (record reading).
3. Turn Receiver back "ON".
4. Place Receiver into serviceman Mode for making electronic adjustment, select DAC Adjustment (Sb).
5. Set (Sb) based on following formula:

$$Sb = 1350128 - \frac{7372800000}{\text{pin 25}}$$

NOTE: After the proper number is loaded into Sb, pin 25 measurement will remain the same as previously measured.

Sample chart for loading Sb (register range is 0 thru 255).

Sb register	pin 25 reading
0	5460.816
1	5460.820
2	5460.824
127	5461.329
128	5461.333
129	5461.337
253	5461.839
254	5461.843
255	5461.847

NOTE: If TPS1 (IC001 pin 25) is measured in Hz unit with the Frequency Counter use following formula:
Sb = 13501028 – [7372.8 x pin 25 (Hz)]
Must have at least four digits of resolution behind decimal point for pin 25 reading.
Sample: 000.0000

Service Adjustments (Mechanical Controls)

RF AGC Delay R106

Adjust only if overloading on strong signal or busy background (snow) is present on moderate strength signals.

1. Adjust RF AGC control R106 until snow appears in picture, then adjust control until snow is eliminated.
2. Check all channels for optimum setting.

AFC Field Adjustment L103

1. Select TV signal mode with Menu.
2. Defeat AFC by applying jumper from TPS7 to ground (⏚).
3. Connect a digital voltmeter to AFC test point TP16.
4. Use Remote Control to Check all active High Band channels 7~13 for AFC voltage range. Select channel with AFC voltage in approximate center of voltage range.
5. Adjust L103 for 4.6V ±0.1V at TP16.
6. Check all active channels for proper AFC correction. Touch up L103 if required. Remove jumper in step 2.

NOTE: Do not use TV/CABLE channel with offset carriers for adjustment or in determination of low and high range of AFC voltage.

Sound Alignment L201

1. Select active TV channel.
2. Attenuate signal (loosely couple antenna lead or use RF attenuator pad) for noisy sound.
   - Adjust L201 for maximum sound. Signal to noise ratio is best when L201 is peaked.
3. Connect antenna or remove RF attenuator for strong signal.

Comb Filter Adjustment (31" Models only) – R3215 and L3202 (X–Board)

1. Connect an NTSC color bar generator (not rainbow generator) to video Input.
2. Normalize Picture Menu Video Adjustments. Then adjust SHARPNESS to Max. and COLOR to Min.
3. Connect an oscilloscope to any of the following: Connector A3 pin 5 (A–Board), TP47G (A–Board), or TP35 (CRT–Board).
4. Set oscilloscope sweep rate to view color burst signal on horizontal sync pulse.
5. Set BALANCE control R3215 fully clockwise. Burst amplitude should increase making it more visible.
6. Adjust phase coil L3202 for Minimum burst amplitude.
7. Re–adjust BALANCE control R3215 for Minimum burst amplitude.
8. Repeat procedure steps 6 & 7.

Vertical Size R453

1. Turn VERTICAL SIZE control R453 CCW until top and bottom edges of raster are visible.
2. Adjust VERTICAL SIZE control CW until top and bottom of raster touch bezel edge. Advance SIZE control CW an additional 30 degrees. This will be approximately 10% overscan. Linearity adjustment is automatic with size adjustment.

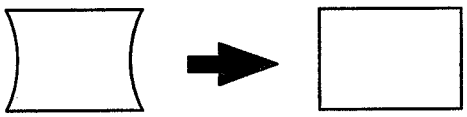
Pincushion Correct (R761) & Horizontal Width (R760) Z–Board (31" Models only)

Preparation

1. Connect crosshatch pattern generator.
2. Normalize the PICTURE Menu Video Adjustments.
3. Adjust Horizontal Width (R760) to MID position.

Procedure

1. Adjust Pincushion Correct Control (R761) for the straightest left and right vertical lines.



2. If needed, adjust Horizontal Width (R760). Adjust for equal horizontal size of right side and left side boxes.

Focus (Part of T551)

Preparation

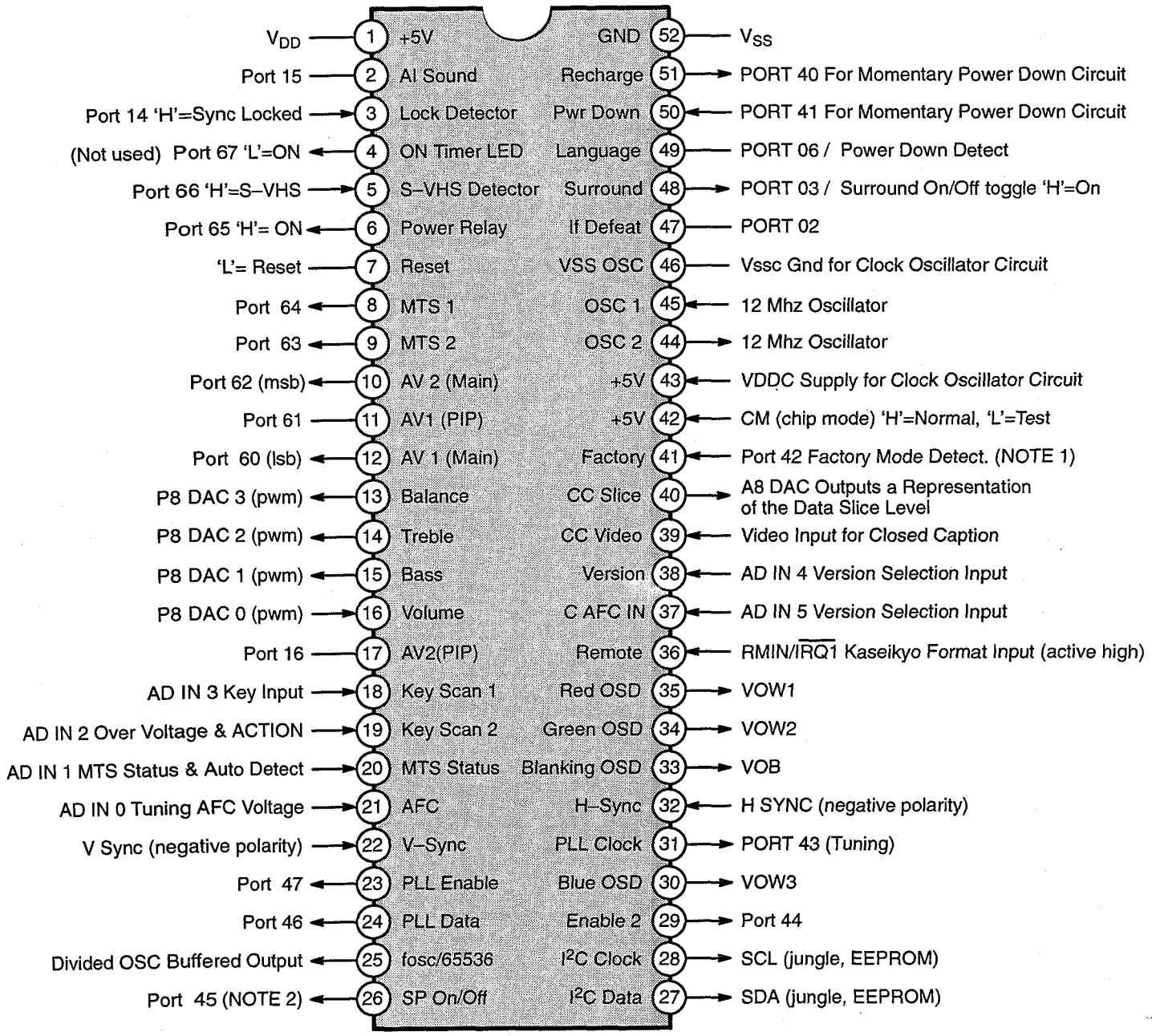
1. Connect Signal generator and select dot pattern.

Procedure

1. Adjust the FOCUS control to obtain the sharpest and clearest dot pattern.
   (a) adjust for best center
   (b) adjust for best area between center and top right corner.

New Circuits

IC001 MPU IN/OUT Pins and Functions

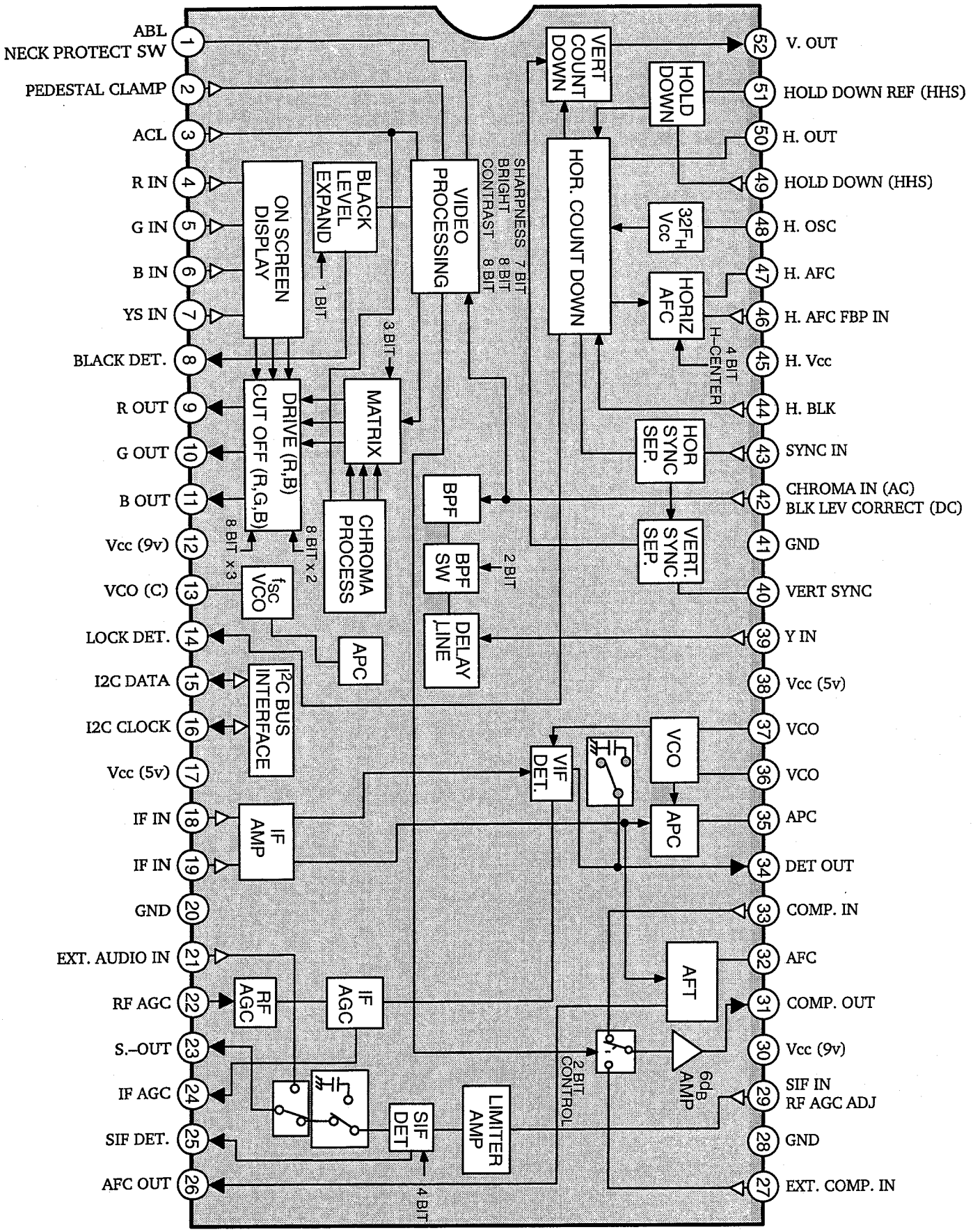

VDD 1 +5V
Port 15 2 AI Sound
Port 14 'H'=Sync Locked 3 Lock Detector
(Not used) Port 67 'L'=ON 4 ON Timer LED
Port 66 'H'=S-VHS 5 S-VHS Detector
Port 65 'H'= ON 6 Power Relay
'L'= Reset 7 Reset
Port 64 8 MTS 1
Port 63 9 MTS 2
Port 62 (msb) 10 AV 2 (Main)
Port 61 11 AV1 (PIP)
Port 60 (lsb) 12 AV 1 (Main)
P8 DAC 3 (pwm) 13 Balance
P8 DAC 2 (pwm) 14 Treble
P8 DAC 1 (pwm) 15 Bass
P8 DAC 0 (pwm) 16 Volume
Port 16 17 AV2(PIP)
AD IN 3 Key Input 18 Key Scan 1
AD IN 2 Over Voltage & ACTION 19 Key Scan 2
AD IN 1 MTS Status & Auto Detect 20 MTS Status
AD IN 0 Tuning AFC Voltage 21 AFC
V Sync (negative polarity) 22 V-Sync
Port 47 23 PLL Enable
Port 46 24 PLL Data
Divided OSC Buffered Output 25 fosc/65536
Port 45 (NOTE 2) 26 SP On/Off
GND 52 VSS
Recharge 51 PORT 40 For Momentary Power Down Circuit
Pwr Down 50 PORT 41 For Momentary Power Down Circuit
Language 49 PORT 06 / Power Down Detect
Surround 48 PORT 03 / Surround On/Off toggle 'H'=On
If Defeat 47 PORT 02
VSS OSC 46 Vssc Gnd for Clock Oscillator Circuit
OSC 1 45 12 Mhz Oscillator
OSC 2 44 12 Mhz Oscillator
+5V 43 VDDC Supply for Clock Oscillator Circuit
+5V 42 CM (chip mode) 'H'=Normal, 'L'=Test
Factory 41 Port 42 Factory Mode Detect. (NOTE 1)
CC Slice 40 A8 DAC Outputs a Representation of the Data Slice Level
CC Video 39 Video Input for Closed Caption
Version 38 AD IN 4 Version Selection Input
C AFC IN 37 AD IN 5 Version Selection Input
Remote 36 RMIN/IRQ1 Kaseikyo Format Input (active high)
Red OSD 35 VOW1
Green OSD 34 VOW2
Blanking OSD 33 VOB
H-Sync 32 H SYNC (negative polarity)
PLL Clock 31 PORT 43 (Tuning)
Blue OSD 30 VOW3
Enable 2 29 Port 44
I2C Clock 28 SCL (jungle, EEPROM)
I2C Data 27 SDA (jungle, EEPROM)

NOTE 1:
Momentarily pulling pin 41 to ground and releasing it will put the microprocessor into factory aging mode. Holding this line at ground will inhibit microprocessor access to I^2C bus line.

NOTE 2:
Speaker On/Off is also used as audio defeat line.

IC101 Block Diagram

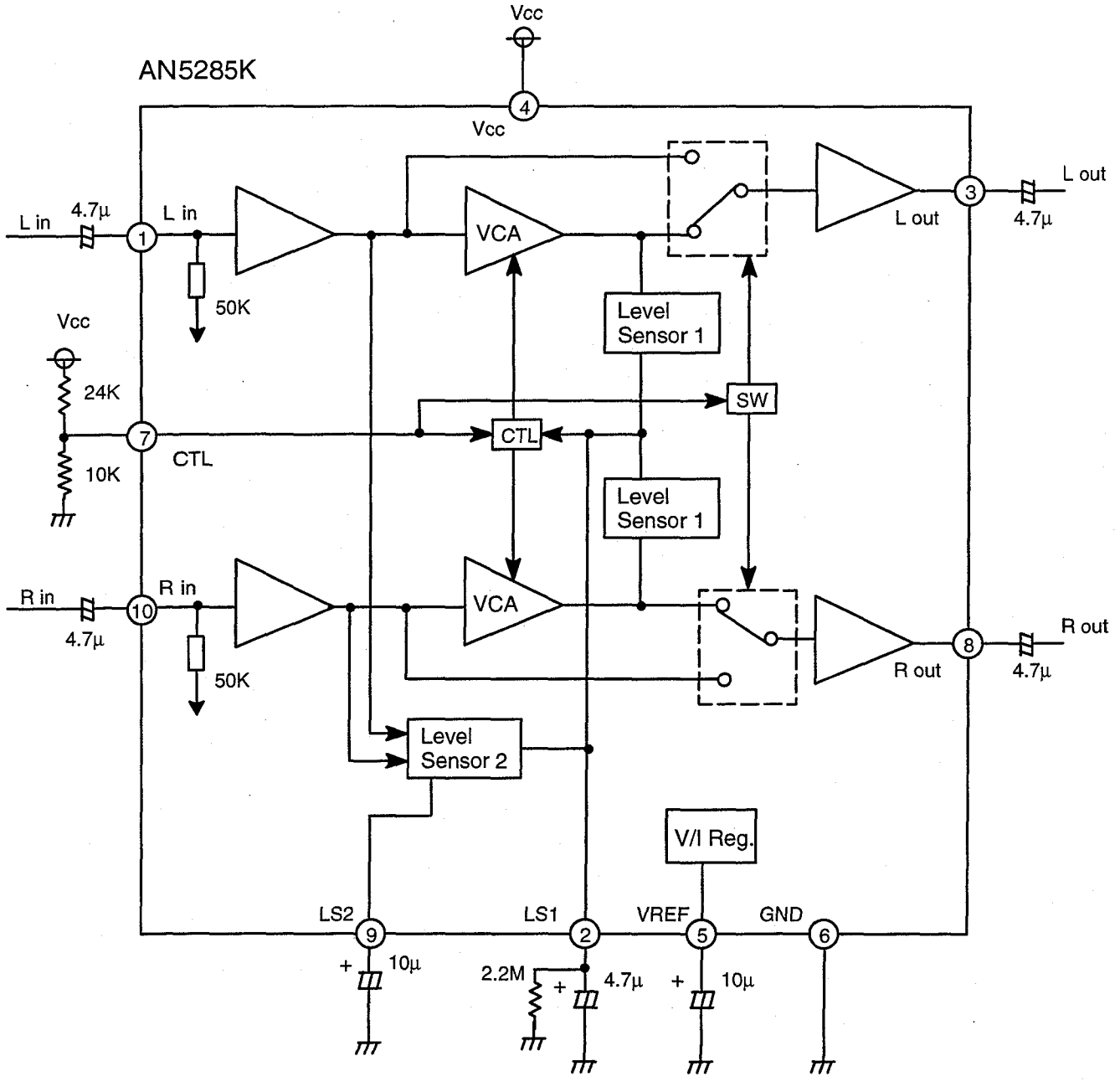
INPUT PINS = ▽ △ OUTPUT PINS = ▲ ▼



*AIS (Artificial Intelligence Sound)

This receiver uses Artificial Intelligence (AI) Sound to modulate abrupt changes in sound volume level. It is primarily designed to prevent sudden loud changes in sound volume, such as those which occur when a television program is interrupted by a commercial. It also equalizes the maximum volume level when switching between different channels or when switching between broadcast and other A/V sources.

The AIS circuit is incorporated into the system through the use of an Automatic Gain Circuit, IC2451, which is located on the X–Board. AIS activation is MPU controled through the IC's switch terminal at pin 7. Right and left channel sound enters the circuit at pins 1 and 10 respectively, where they are sampled, then either amplified or dampened according to preset levels. The "streamlined" sound is then outputed through pins 3 and 8 (left and right channels respectively).

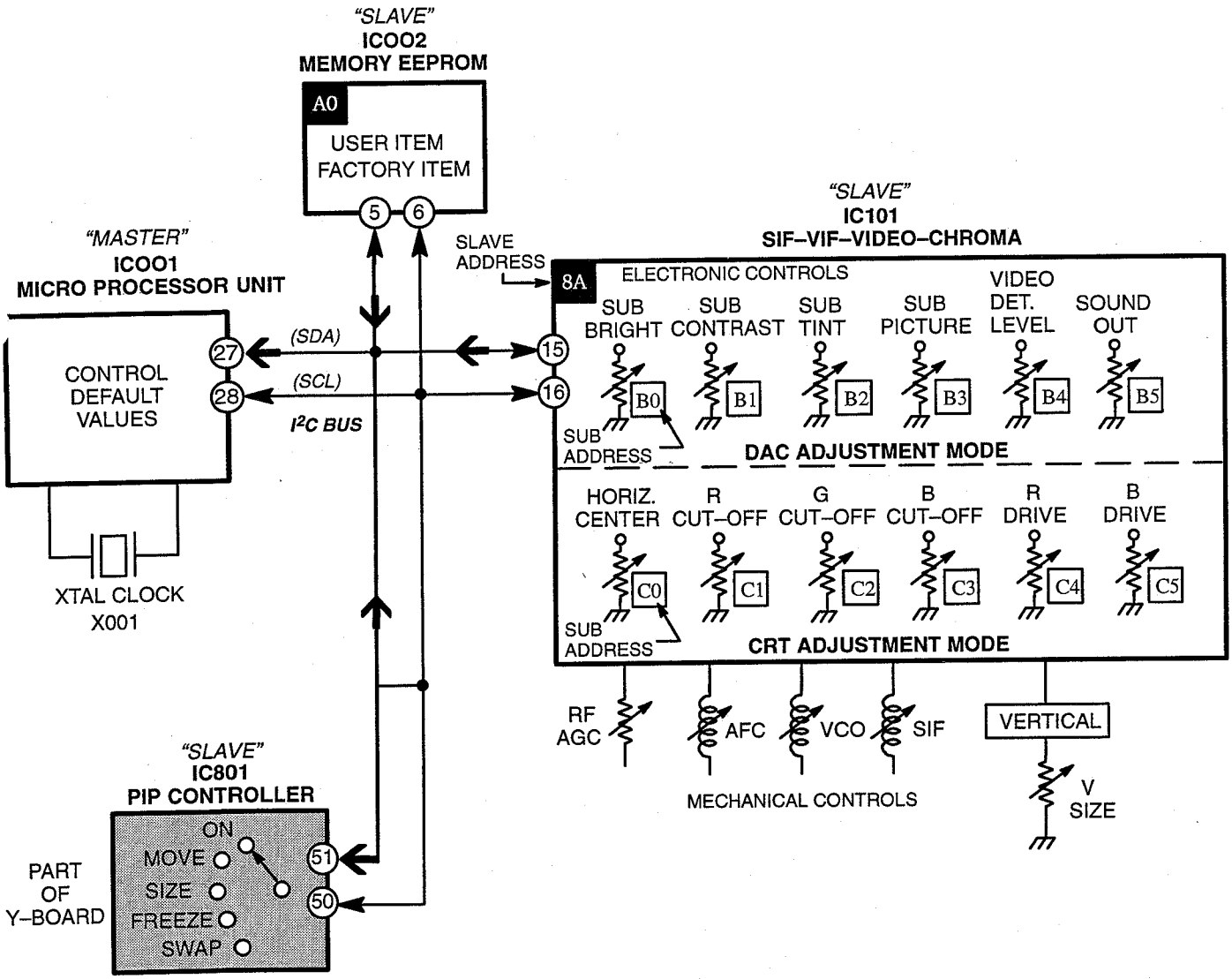


I²C Bus Line System

This Receiver makes use of one of the latest electronic technologies by using an I²C (Inter–Integrated Circuit) Bus Line Concept. Two wires, SDA (Serial Data) and SCL (Serial Clock) carry information between devices connected to the Bus. Each device connected to the Bus has a unique address for receiving data information (a Receiver) from a source (the Transmitter).

The devices are also considered to be a "Master" or a "Slave" when data is transmitted or received. In this Receiver, the "Master" (Micro Processor Unit,IC001) is the device which initiates a data transfer in the Bus line and generates the clock signal required to permit the data to be sent. The "Slaves" (MEMORY I²C EEPROM, IC002, VIF–SIF–VIDEO–CHROMA JUNGLE, IC101 and PIP Controller, IC1801) are the devices addressed by the MPU and receive the data transmitted.

This system usually performs as a control function and replaces many of the required mechanical controls needed in a television receiver. Instead of adjusting various mechanical controls individually, many of the control functions can be performed electronically using "On Screen Menus", (The Serviceman Mode).



Switching Power Supply

B+ source voltages are produced at the secondary of T801 by high frequency switching of a MOSFET transistor inside IC801. Also included in the STK730–020 package is an Amplifier, Error Detector and Over Current Protection circuit. Altogether, these circuits produce a semi regulated off line power supply circuit which require few external parts.

Operation

The switching action is done in the following way:

Starter voltage from the bridge rectifier is applied to IC801 pin 4 (the Gate of MOSFET,TR1) through resistors R814 and R808. TR1 turns ON and Drain current starts to flow through the primary winding (NP) of T801. At the same time a voltage is induced at the ND1 winding which keeps a voltage on the Gate and TR1 stays ON. Drain current continues to flow and increases the voltage across the current detecting resistor R805 (IC801 pin 8). This induced voltage is integrated by the R/C time constant of IC801 internal resistor R3 and external capacitor C828 (pin 7). The voltage is applied to the Base of IC801 internal transistor TR3.

Regulation

The primary winding of T801 (NP) and the secondary windings (NS) are wired with opposite polarity. When TR1 is conducting. The current flows through winding NP. The secondary windings (NS) have no current because the B+ rectifier diodes block the flow.

The current flowing through TR1 and NP winding increases at a linear rate. When the voltage between Pins 1 and 3 of IC801 reach a fixed voltage of approximately 40.5V, TR1 turns OFF by the operation of IC801 internal error amp. This provides a state of regulation.

The secondary windings NS are wired so their voltages are in proportion to the voltage across the ND2 winding. Therefore output voltage is controlled by the error amp monitoring the voltage across ND2 winding and controls the conduction of TR1.

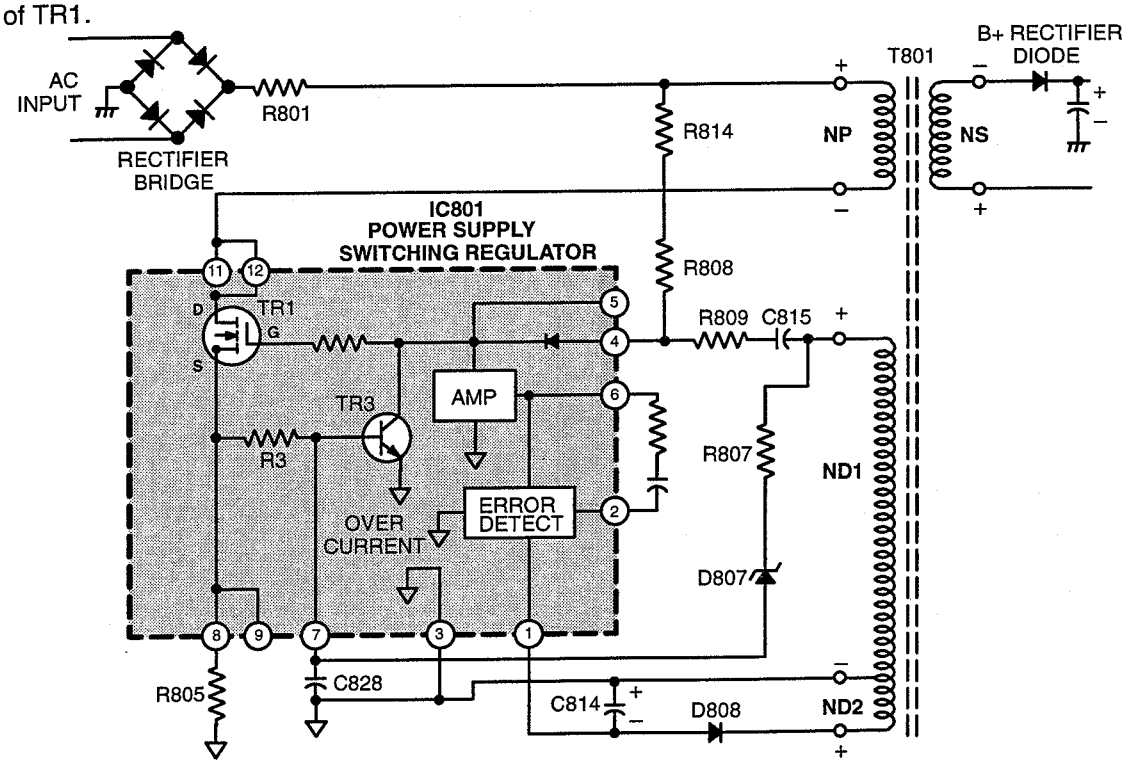
When TR1 turns OFF, the energy stored in T801 primary winding (NP) collapses and induces an opposite polarity voltage across the secondary windings (NS). B+ Rectifier diodes now conduct and allow current flow. When the total energy has collapsed at the primary winding, the ND2 winding also has a low voltage. The voltage across IC801 Pins 1 and 3 is now less than 40.5V and the internal error amp turns OFF to allow TR1 to conduct again. Reverse voltage polarity is again induced across the primary winding. This series of events repeats and the voltages of the secondary windings increase. When TR1 turns OFF, the energy is transferred to the secondary windings and TR1 is turned back on by the backswing. A stable oscillation begins.

Over Current/Voltage Protection

The over current/voltage protection circuit consist of IC801 internal components R3,TR3 and external components R805 (Pins 8, 9), R807, D807 (Pin7). Capacitor C828 (Pin 7) filters the base bias voltage of internal transistor TR3.

When output power increases because of a defect in a B+ source and excessive current flows, the Source current of TR1 increases. The voltage drop across R805 increases to cause oscillation frequency to decrease. Thus output voltage lowers. In other words, when the voltage drop across R805 increases, the base bias for TR3 also increases. When the bias reaches 0.6V,TR3 conducts and loads down the TR1 Gate bias to turn TR1 OFF. At the same time, the ND1 winding's current flows through R807 and D807 to produce a negative voltage and prevents TR1 from turning ON, as an overvoltage protection.

The Source current of TR1 is a triangular wave shape. When output current increase, the on time of TR1 stays constant but the off time becomes longer. As a result, frequency decreases and the output power decreases for over current/voltage protection.



Power Supply Protection

A new feature has been added to the NA3D chassis family. MPU (IC001). Pin 19 is a dual function Pin. The ACTION button function is activated when Pin 19 voltage is 0.588V or less. An Over Voltage Protect function is activated when Pin 19 voltage is 3.2V or higher.

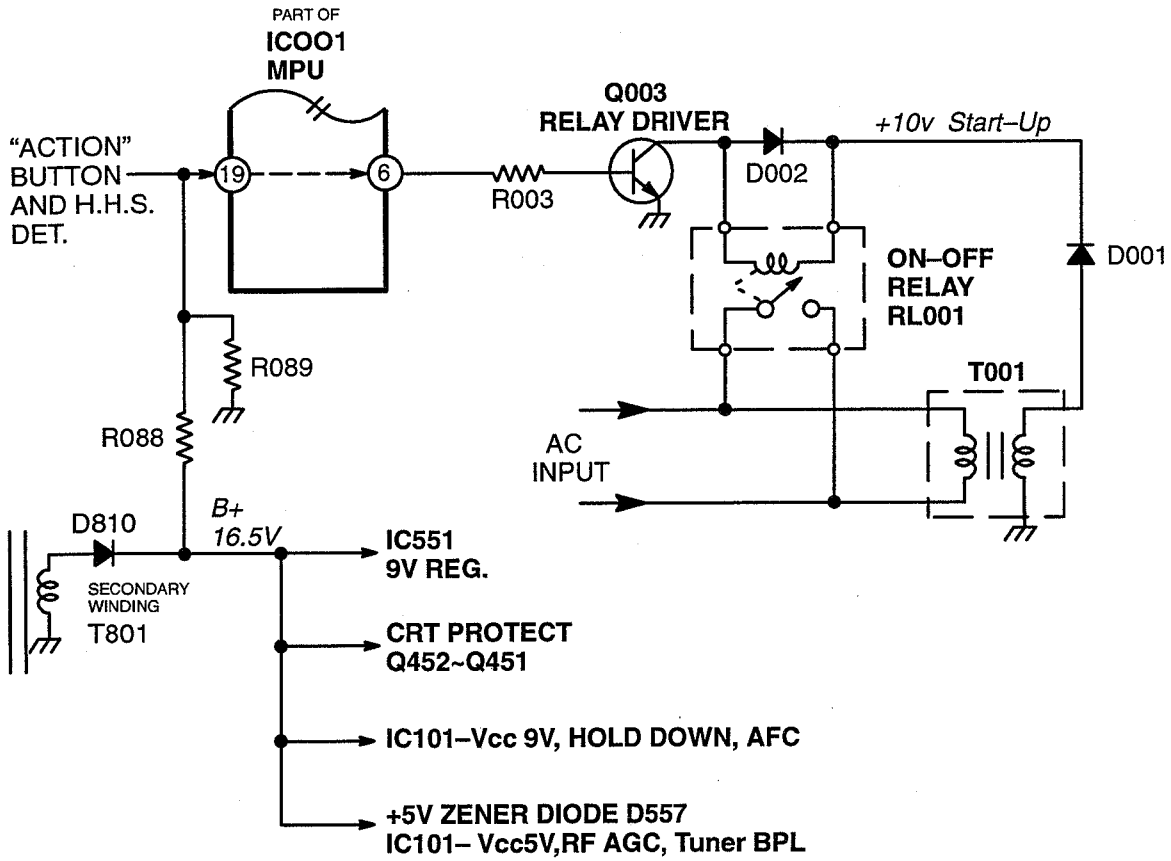
With the Receiver on, the power supply B+ 16.5V is monitored and voltage divided by R088/R089. As long as the voltage at IC001 Pin 19 is 0.6V~3.1V (depending on power supply operation) the Receiver operates normally.

If a major power supply switching I.C. failure occurs, the power supply may far exceed the normal +16.5V ±2V specification. IC001 Pin 19 voltage will increase above 3.2V and internal circuitry of the IC will cause Pin 6 (power) to go low. When this happens, the base of Q003 is held low and it can not conduct. Relay RL001 deenergizes to open the on contact in the relay and shuts the Receiver off.

This condition will remain until AC power is momentarily disconnected.

If when pressing the power button after AC is applied again and the Receiver comes on but goes off after a few seconds, there is a problem in the Receiver's power supply.

WARNING: Because Pin 19 is a dual function Pin, do not press the "ACTION" button on the Receiver. Pressing the button when the above symptom appears will inhibit the Overvoltage Protection and if the Receiver is powered on again, severe damage may happen to the entire chassis. If IC801 is changed to correct a power supply failure, also check or change D806, D807and D808 before reapplying power to the chassis. During a major failure, these components can fail, causing the I.C. to appear to operate normally, but it may run very hot, leading to another I.C. failure very quickly.



Horizontal Hold Down Circuit

This circuit protects against excessive high voltage and CRT beam current. If for any reason high voltage and/or CRT beam current exceeds a predetermined level, the Hold Down Circuit operates to increase horizontal frequency. If the level increases more, the Hold Down Circuit will blank the CRT.

CRT heater voltage from pin 6 of flyback transformer (FBT) T551 is rectified by diode D531. This voltage is directly proportional to high voltage variations. The voltage is filtered and divided down by precision resistors R532/R533 to approximately 2.4V and applied to Pin 49 (Hold Down) of IC101. With this voltage as a normal condition, the Hold Down Circuit is inactive and has no effect on horizontal frequency or blanking the CRT.

The Hold Down Circuit inside IC101 is a (NPN) differential amp. One base of the differential amp is connected to Pin 49 (approximately 2.4V). The other is connected to Pin 51 through an internal voltage divided of equal resistance. Pin 51 is clamped at a 6V DC reference voltage zoner zener diode D532. The voltage at the base of the differential amp is 3V. (1/2 of the reference voltage, 6V)

Basically, the Hold Down Circuit compares the voltage at Pin 49 (approximately 2.4V) to half of Pin 51 (clamped 6V). If CRT heater pulse amplitude from T551 (representative of high voltage) increases, the positive voltage at the cathode of D531 and at Pin 49 of IC101 also increase.

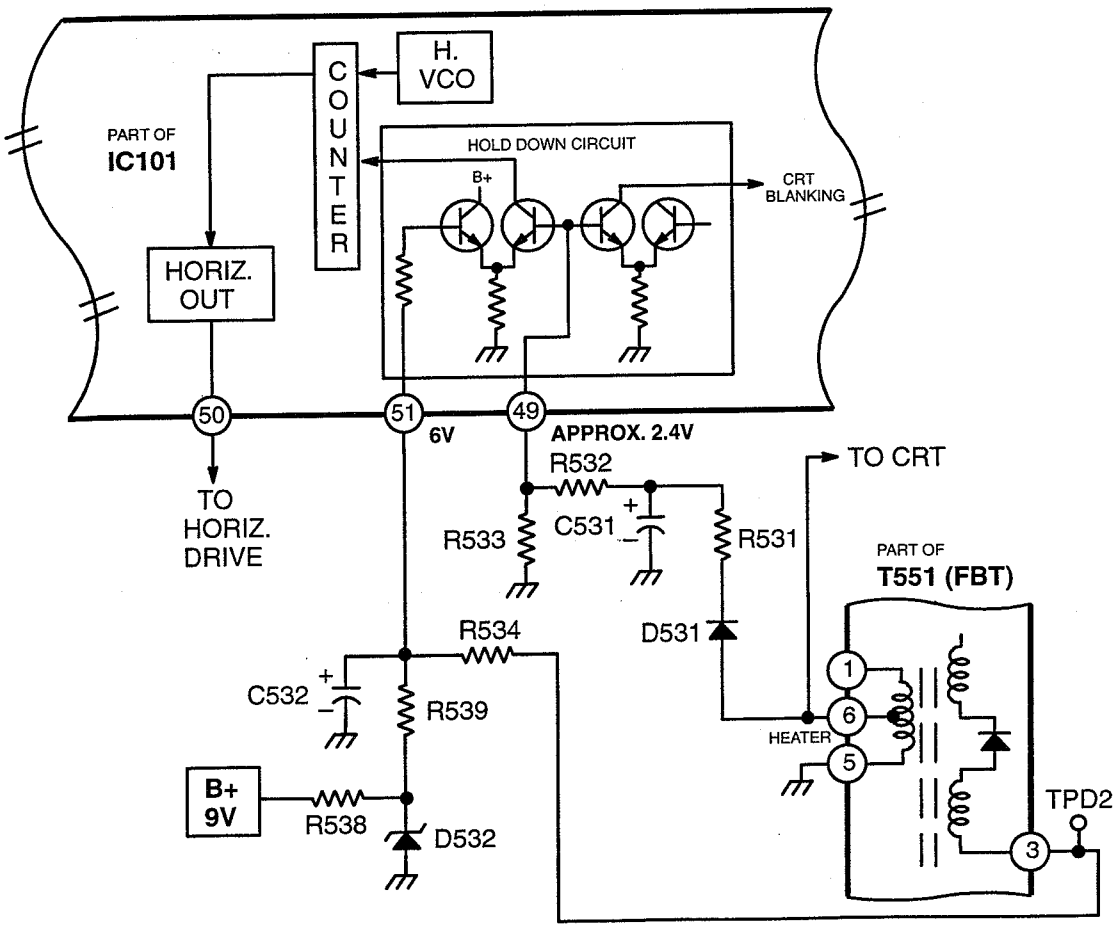
When the increased DC voltage at Pin 49 exceeds half of the Pin 51 reference voltage by a predetermined amount, the Hold Down Circuit (differential amp) changes conduction state and shifts the horizontal count down for a higher sweep frequency (out of sync condition) to prevent unsafe operation. For further safety when the Pin 49 voltage is extremely excessive, another internal differential amp changes state to blank the CRT.

An increase in CRT beam current produces more negative ABL voltage at Pin 3 of T551 (FBT) which is coupled to Pin 51 of IC101 via resistor R534. This increased negative voltage opposes the positive voltage at Pin 51 and lowers the DC reference voltage to less than 6V. This in turn causes the Hold Down Circuit to operate sooner when Pin 49 voltage increases.

Thus excessive levels of high voltage and/or increased CRT beam current cause determining of the horizontal oscillator frequency and eventual blanking of the CRT to assure operation within safe limits.

The B+ circuit and the Hold Down Circuit are not adjustable. If components in the designated areas of the schematic for critical parts are changed, operation of the Hold Down Circuit must be checked to insure that high voltage and CRT beam current does not exceed safe operation parameters. Check the following for possible failure:

1. Measure the DC voltage at Pin 49 of IC101 (reading should be close to +2.4V). If not, check D531, R531, C531, R532, R533 and IC101.
2. Measure the DC voltage at Pin 51 of IC101. (reading should be +6V) if not, check R534, C532, R539, D532, R538 and IC101.



CRT Protection Circuit

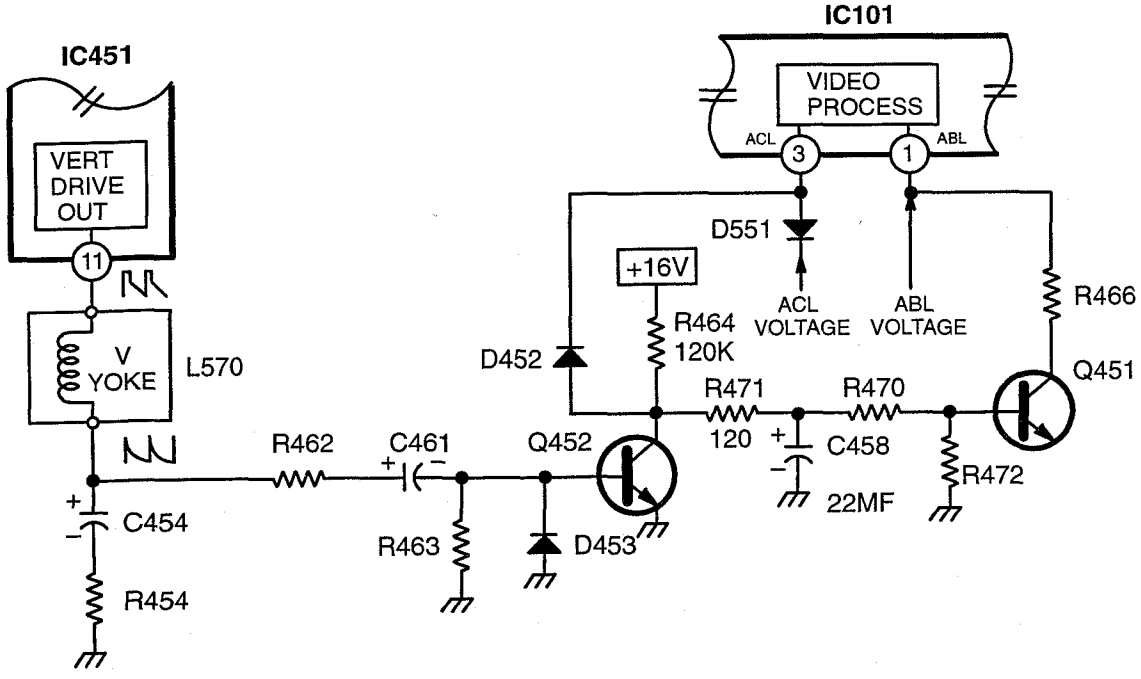
The CRT Protection Circuit is made up of transistors Q452 and Q451. The circuit blanks the CRT in the event of vertical sweep loss.

During normal operation, Q452 monitors vertical sweep by being connected to the low side of the vertical yoke L570. When Q452 is off, C458 starts to charge up from the 16V source through resistors R464 and R471. The RC time constant is such that the charging is slow. When Q452 is conducting, C458 discharges through R471 and the transistor to ground. The RC time constant is such that the discharge is fast. The slow charging and fast discharging along with voltage divider R470/R472 prevents sufficient bias for transistor Q451 to conduct. With Q451 not conducting, Pin 1 of IC101 is high and ABL functions normally.

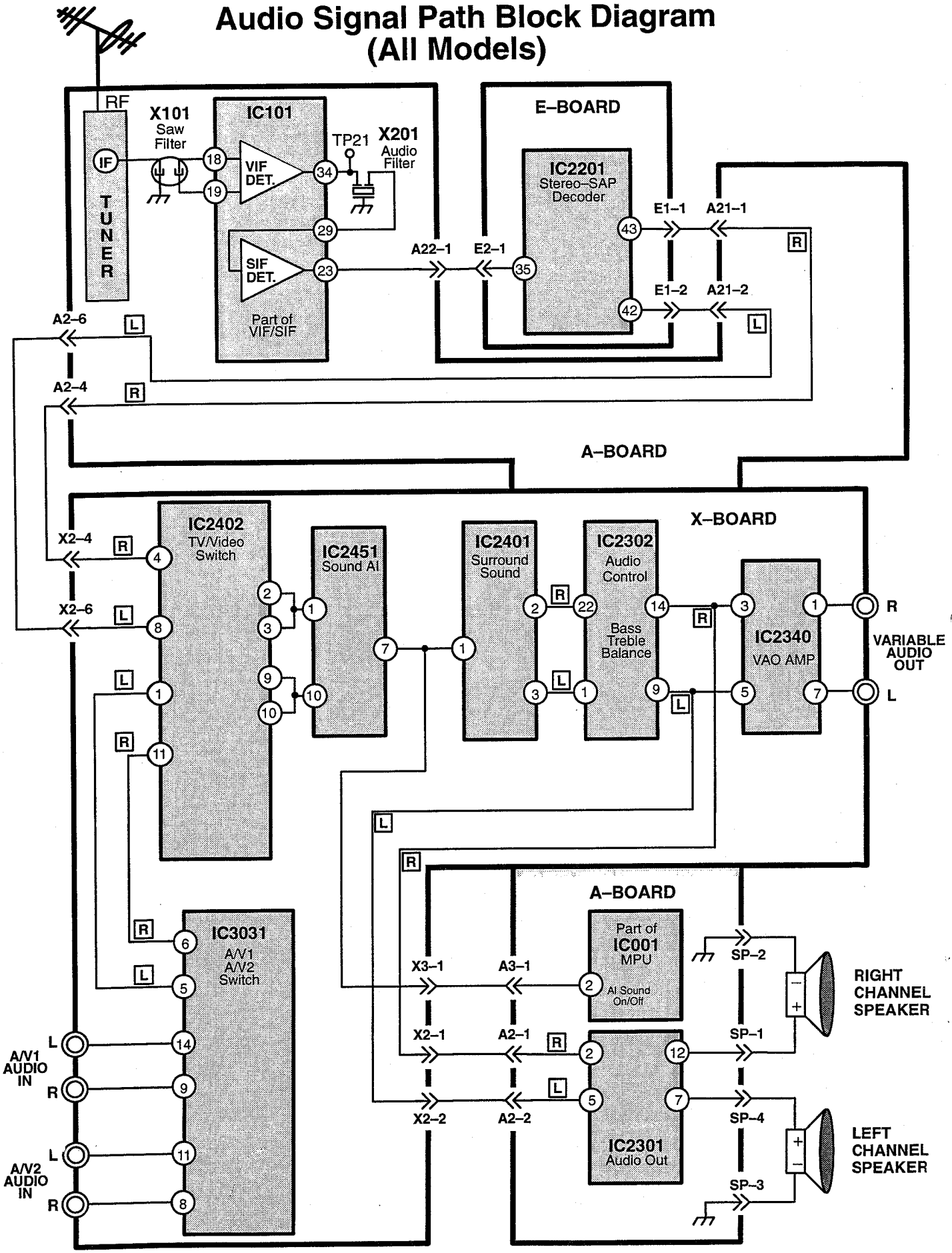
If yoke current ceases (due to an open yoke or no voltage at IC451 Pin 11), there is no base bias for transistor Q452. The transistor is now always non conductive. Capacitor C458 is now allowed to charge a longer time to supply enough bias through voltage divider R470/R472 for Q451 to conduct. When it does, the voltage at Pin 1 of IC101 goes low and cuts off CRT beam current.

Diode D452 is added to the collector of Q452 to prevent the circuit from operation when Pin 3 of IC101 is grounded for Service Switch function when setting CRT cutoff.

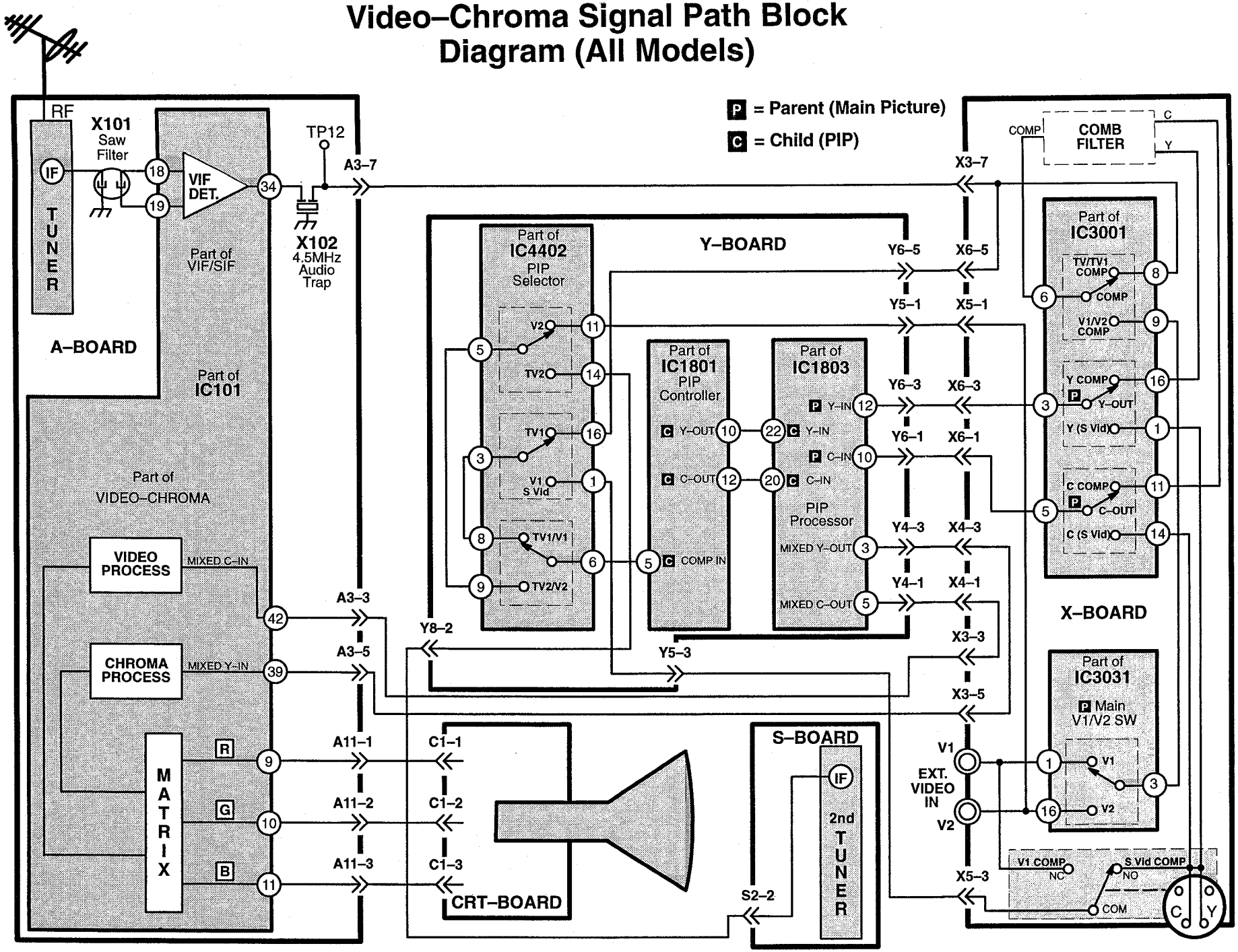
It is important for CRT life that this circuit be checked before returning a repaired receiver to a customer. A quick test is to short Q452 base to ground. The CRT should blank. If not, troubleshoot the circuit for cause.



Audio Signal Path Block Diagram (All Models)



Video–Chroma Signal Path Block Diagram (All Models)



Service Notes

Leadless Chip Components

Chip transistors must be replaced with identical chip components due to critical foil track spacing. There are no holes in the board to mount standard transistors or diodes. Some chip capacitor or resistor board solder pads may have holes thru the board but hole diameter limits standard resistor replacement to 1/8 watt. Standard capacitor replacement may also be limited for the same reason. It is recommended that identical chip components be used for replacement purposes.

Chip resistors have a three digit numerical resistance code – 1st and 2nd significant digits and a multiplier. Example: 162=1600 or 1.6K ohm resistor, 0=0 ohms (jumper).

Chip capacitors generally do not have the value indicated. The body color indicates a general range of capacity.

Chip transistors are identified by a two letter code. The first letter indicates the type and the second letter, the grade of transistor. See coding chart.

Chip diodes have a two letter identification code as per the code chart and are a dual diode pack with either common anode or common cathode. Check the parts list for correct diode number.

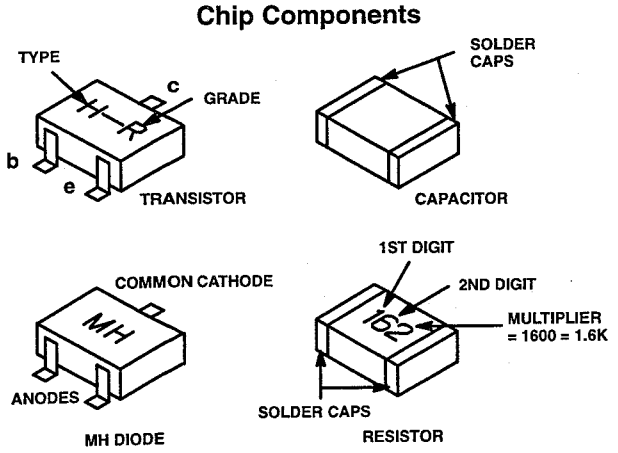
Component Removal

1. Use solder wick to remove solder from component end caps or terminals.
2. Without pulling up, carefully twist the component with tweezers to break the adhesive.
3. Do not reuse removed leadless or chip components since they are subject to stress fracture during removal.

Chip Component Installation

1. Put small amount of solder on board soldering pads.
2. Hold chip component against soldering pads with tweezers or a miniature alligator clip and apply heat to pad area with 30 watt iron until solder flows. Do not apply heat for more than 3 seconds.
3. Remove iron and continue to hold component against pads until solder solidifies.

Chip Components

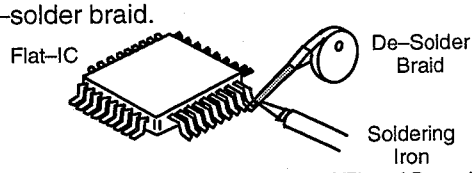


How to Replace Flat–IC

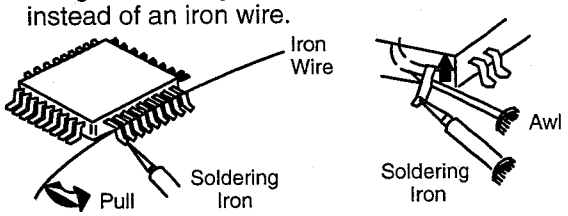
– Tools Required –

- Soldering iron
- De–solder braids
- Iron wire or small awl
- Magnifier

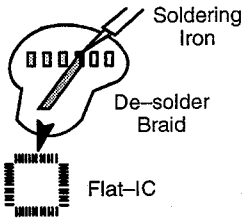
1. Remove the solder from all pins of Flat–IC by using de–solder braid.



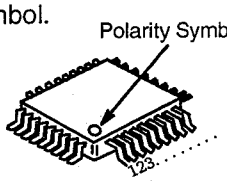
2. Put an iron wire under the pins of Flat–IC and pull it in the directions indicated while heating the pins using a soldering iron. A small awl can be used instead of an iron wire.



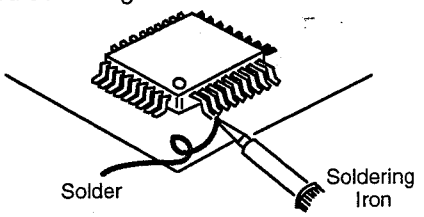
3. Remove the solder from all pads of Flat–IC by using de–solder braid.



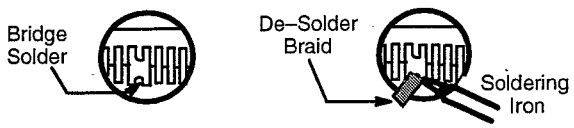
4. Put the new Flat–IC in place (apply the pins of Flat–IC to the soldering pads where the pins must be soldered). Properly determine the positions of the soldering pads and pins by correctly aligning the polarity symbol.



5. Solder all pins to the soldering pads using a fine tipped soldering iron.



6. Check with a magnifier for solder bridge between the pins or dry joint between pins and soldering pads. To remove solder bridge, use de–solder braid as shown in figure.



NOTE: ***These components are affixed with glue. Be careful not to break or damage any foil under the component or at the pins of IC's when removing. Usually applying heat to the component for a short time while twisting with tweezers will break the compound loose.***

REPLACEMENT PARTS LIST

(Models: CT–27G30T, CT–31G30T, CT–27G30C, CT–27G30UT, CT–31G30UT)

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION
		CAPRISTORS
CRA801	**EXNG131P365**	**RES–CAP 130PF/3.6 MEG**
CRA802	**EXNG131P365**	**RES–CAP 130PF/3.6 MEG**
		CAPACITORS
C001	ECKF1H103ZF	CAP,C .01UF–Z–50V
C002	ECA1EM4R7GB	CAP,E 4.78F/25V
C003	ECKF1H103ZF	CAP,C .01UF–Z–50V
C004	ECKF1H101KB	CAP,C 100PF–K–50V
C005	ECKF1H101KB	CAP,C 100PF–K–50V
C006	ECKF1H101KB	CAP,C 100PF–K–50V
C007	ECKF1H101KB	CAP,C 100PF–K–50V
C008	ECA0JM331GB	CAP,E 330UF/10V
C009	ECA1CM100GB	CAP,E 10/16V
C010	ECA1CM100GB	CAP,E 10/16V
C011	ECA1CM100GB	CAP,E 10/16V
C012	ECA1HM010GB	CAP,E 1.0UF/50V
C014	ECA0JM102GB	CAP,E 1000UF/6.3V
C015	ECA1HM010GB	CAP,E 1.0UF/50V
C017	ECA0JM101GB	CAP,E 100UF/6.3V
C019	ECKF1H103ZF	CAP,C .01UF–Z–50V
C021	ECKF1H101KB	CAP,C 100PF–K–50V
C022	ECCF1H330JC	CAP,C 33PF–J–50V
C023	ECCF1H330JC	CAP,C 33PF–J–50V
C024	ECKF1H101KB	CAP,C 100PF–K–50V
C025	ECKF1H101KB	CAP,C 100PF–K–50V
C026	ECA1CM102GE	CAP,E 1000UF/16V
C035	ECKF1H103ZF	CAP,C .01UF–Z–50V
C036	ECA0JM101GB	CAP,E 100UF/6.3V
C037	ECA0JM101GB	CAP,E 100UF/6.3V
C045	ECA1CM471GB	CAP,E 470UF/10V
C046	ECKF1H103ZF	CAP,C .01UF–Z–50V
C047	ECA1CM221GB	CAP,E 220/16V
C060	ECKF1H103ZF	CAP,C .01UF–Z–50V
C064	ECKF1H392KB	CAP,C .0039–K–50V
C101	ECKF1H103ZF	CAP,C .01UF–Z–50V
C102	ECA1CM100GB	CAP,E 10/16V
C103	ECKF1H103ZF	CAP,C .01UF–Z–50V
C104	ECA1HMR22GB	CAP,E .22UF/50V
C105	ECCF1H270JC	CAP,C 27PF–J–50V
C106	ECKF1H122KB	CAP,C .0012UF–K–50V
C107	ECA1HMR47GB	CAP,E .47UF/50V
C109	ECA0JM101GB	CAP,E 100UF/6.3V
C110	ECKF1H103ZF	CAP,C .01UF–Z–50V
C113	ECA1CM100GB	CAP,E 10/16V
C114	ECKF1H102KB	CAP,C .001UF–K–50V
C123	ECCF1H010CC	CAP,C 1PF–C–50V
C126	ECA1CM331GB	CAP,E 330/16V
C147	ECCF1H330JC	CAP,C 33PF–J–50V
C151	ECA1HMR22GB	CAP,E .22UF/50V
C152	ECCF1H680JC	CAP,C 68PF–J–50V
C153	ECCF1H150JC	CAP,C 15PF–J–50V
C201	ECCF1H680JP	CAP,C 68PF–J–50V
C202	ECKF1H103ZF	CAP,C .01UF–Z–50V
C203	ECKF1H103ZF	CAP,C .01UF–Z–50V
C207	ECEA1CN100S	CAP,E 10UF/16V
C301	ECEA1CN100S	CAP,E 10UF/16V
C302	ECA1AM331GB	CAP,E 330UF/10V
C303	ECA1CM220GB	CAP,E 22UF/16V
C304	ECA1EM4R7GB	CAP,E 4.78F/25V
C305	ECA1HMR33GB	CAP,E .33UF/50V
C306	ECA1EM4R7GB	CAP,E 4.78F/25V
C309	ECEA1HN010S	CAP,E 1UF/50V
C310	ECA1CM100GB	CAP,E 10/16V
C311	ECQB1H473KF	CAP,P .047UF–K–50V
C312	ECA1CM220GB	CAP,E 22UF/16V
C313	ECCF1H390K	CAP,C 39PF–K–50V
C315	ECKF1H151KB	CAP,C 150PF–K–50V
C316	ECKF1H181KB	CAP,C 180PF–K–50V
C351	ECKF1H561KB	CAP,C 560PF–K–50V CT–31G30TM CT–31G30UTM
C351	ECKF1H821KB	CAP,C 820PF–K–50V CT–27G30TM CT–27G30CTC CT–27G30UTM
C352	ECKF1H561KB	CAP,C 560PF–K–50V CT–31G30TM CT–31G30UTM
C352	ECKF1H821KB	CAP,C 820PF–K–50V CT–27G30TM CT–27G30CTC CT–27G30UTM
C353	ECKF1H681KB	CAP,C 680PF–K–50V CT–31G30TM CT–31G30UTM
C353	ECKF1H821KB	CAP,C 820PF–K–50V CT–27G30TM CT–27G30CTC CT–27G30UTM
C355	ECKD3D102KB	CAP,C .001UF–K–2KV
C357	ECKF1H103ZF	CAP,C .01UF–Z–50V
C401	ECA1HMR33GB	CAP,E .33UF/50V
C402	ECKF1H331KB	CAP,C 330PF–K–50V
C403	ECEA1HN010S	CAP,E 1UF/50V
C451	**ECEA1CGE221**	**CAP,E 220UF/16V**
C452	ECSF1EE105	CAP,T 1.0UF/25V
C453	ECEA1HFS2R2	CAP,E 2.2UF/50V
C454	ECEA1EGE102	CAP,E 1000UF/25V
C455	ECEA1VGE101	CAP,E 100UF/35V
C456	ECQB1H224KF	CAP,P .22UF–K–50V
C457	ECEA1HGE0R1	CAP,E .1UF/50V
C458	ECA1EM4R7GB	CAP,E 4.78F/25V
C461	ECEA1HGE010	CAP,E 1UF/50V
C462	ECQM1104JZ	CAP,P .1UF–J–100V
C464	ECQB1H563JF	CAP,P .056UF–J–50V
C501	ECKD2H821KB	CAP,C 820PF–K–500V CT–27G30TM CT–27G30CTC CT–27G30UTM
C501	ECKF1H821KB	CAP,C 820PF–K–50V CT–31G30TM CT–31G30UTM
C502	ECA1HM010GB	CAP,E 1.0UF/50V
C503	ECQB1H103KF	CAP,P .01UF–K–50V
C504	ECQB1H103KF	CAP,P .01UF–K–50V
C505	ECQB1H223KF	CAP,P .022UF–K–50V CT–31G30TM CT–31G30UTM
C505	ECQB1H333KF	CAP,P .033UF–K–50V CT–27G30TM CT–27G30CTC CT–27G30UTM

REPLACEMENT PARTS LIST

(Models: CT–27G30T, CT–31G30T, CT–27G30C, CT–27G30UT, CT–31G30UT)

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION
C506	ECA1AM221GB	CAP,E 220UF/10V
C507	ECKF1H221KB	CAP,C 220PF–K–50V
C508	ECQB1H223KF	CAP,P .022UF–K–50V
C509	ECCF1H221JU	CAP,C 220PF–J–50V
C510	ECCD2H100D	CAP,C 10PF–D–500V
C511	ECKD2H821KB	CAP,C 820PF–K–500V
C515	ECKD2H101KB	CAP,C 100PF–K–500V
C517	ECKF1H103ZF	CAP,C .01UF–Z–50V
C531	ECA1EM330GB	CAP,E 33UF/25V
C532	ECA1AM220GB	CAP,E 22UF/10V
C541	ECCF1H680JP	CAP,C 68PF–J–50V
C542	ECKF1H101KB	CAP,C 100PF–K–50V
C543	ECKF1H221KB	CAP,C 220PF–K–50V
C551	ECA0JM222GE	CAP,E 2200UF/6.3V
C552	ECKF1H103ZF	CAP,C .01UF–Z–50V
C553	ECA1CM100GB	CAP,E 10/16V
C555	ECEA2EU220	CAP,E 22UF/250V
C556	ECKD2H561KB	CAP,C 560PF–K–500V
C557	ECEA1CGE221	CAP,E 220UF/16V
C558	ECA1CM331GB	CAP,E 330/16V
C560	ECEA2AU220	CAP,E 22UF/100V
C561	ECA1HM2R2GB	CAP,E 2.2UF/50V
C562	**ECQF2H434JS**	**CAP,P .43UF–J–200V**
		CT–31G30TM CT–31G30UTM
C562	**ECQF2H474JS**	**CAP,P .47UF–J–200V**
		CT–27G30TM CT–27G30CTC
		CT–27G30UTM
C563	**ECWH12H103JS**	**CAP,P .01UF–J–1.2KV**
		CT–31G30TM CT–31G30UTM
C563	**ECWH12H682JS**	**CAP,P .0068UF–J–1.2KV**
		CT–27G30TM CT–27G30CTC
		CT–27G30UTM
C564	**ECWH12H392JS**	**CAP,P .0039UF–J–1.2KV**
		CT–31G30TM CT–31G30UTM
C564	**ECWH12H562JS**	**CAP,P .0056UF–J–1.2KV**
		CT–27G30TM CT–27G30CTC
		CT–27G30UTM
C565	**ECKD3D102JB**	**CAP,C .001UF–J–2KV**
		CT–27G30TM CT–27G30CTC
		CT–27G30UTM
C565	**ECKD3D821JB**	**CAP,C 820PF–J–2KV**
		CT–31G30TM CT–31G30UTM
C566	**ECKD3D181JB**	**CAP,C 180PF–J–2KV**
C567	**ECQM2153JZ**	**CAP,P .015UF–J–200V**
		CT–31G30TM CT–31G30UTM
C568	ECQF2563JZH	CAP,P .056UF–J–200V
		CT–31G30TM CT–31G30UTM
C568	ECQM2274JZ	CAP,P .27UF–J–200V
		CT–27G30TM CT–27G30CTC
		CT–27G30UTM
C569	**ECEA160V33Z**	**CAP,E 33UF/160V**
C571	ECEA1EGE100	CAP,E 10UF/25V
C601	ECCF1H101J	CAP,C 100PF–J–50V
C602	ECCF1H150JU	CAP,C 15PF–J–50V
C607	ECCF1H101J	CAP,C 100PF–J–50V
C754	ECQB1H104KF	CAP,P .1UF–K–50V

REF. NO.	PART NO.	DESCRIPTION
		CT–31G30TM CT–31G30UTM
C755	ECQB1H104KF	CAP,P .1UF–K–50V
		CT–31G30TM CT–31G30UTM
C756	ECEA0JU221	CAP,E 220UF/6.3V
		CT–31G30TM CT–31G30UTM
C757	ECA1VM102E	CAP,E 1000UF/35V
		CT–31G30TM CT–31G30UTM
C759	ECQE1395KN	CAP,P .068UF–K–100V
		CT–31G30TM CT–31G30UTM
C801	ECKD2H472PU	CAP,C .0047UF–P–500V
C802	ECKD2H472PU	CAP,C .0047UF–P–500V
C803	ECKD2H472PU	CAP,C .0047UF–P–500V
C804	ECKD2H472PU	CAP,C .0047UF–P–500V
C805	**EC0S2DA471BB**	**CAP,E 470UF/160V**
C806	**ECQU2A153MN**	**CAP,P .015UF–M–250VAC**
C807	**ECQU2A153MN**	**CAP,P .015UF–M–250VAC**
C809	**ECQU2A224MN**	**CAP,P .22UF–M–250VAC**
C810	ECQM2473KZ	CAP,P .047UF–K–200V
C811	ECKD3A102KB	CAP,C .001UF–K–1KV
C812	ECKD3A102KB	CAP,C .001UF–K–1KV
C813	ECKD2H152KB	CAP,C .0015UF–K–500V
C814	ECEA1JFS220	CAP,E 22UF/63V
C815	ECQB1H273KF	CAP,P .027UF–K–50V
C816	ECKD3A152KB	CAP,C .0015UF–K–1KV
C817	ECKD3A102KB	CAP,C .001UF–K–1KV
C818	**EC0S2DA221B4**	**CAP,E 220UF/200V**
C819	ECKD2H391KB	CAP,C 390PF–K–500V
C820	ECEA1VGE102	CAP,E 1000UF/35V
C821	ECKD2H102KB	CAP,C .001UF–K–500V
C822	**ECEA1EGE102**	**CAP,E 1000UF/25V**
C823	ECKD2H561KB	CAP,C 560PF–K–500V
C824	ECEA1EGE222	CAP,E 2200UF/25V
C828	ECQB1H473KF	CAP,P .047UF–K–50V
C829	ECKD2H331KB	CAP,C 330PF–K–500V
C831	ECA1VM102GE	CAP,E 1000UF/35V
C1021	ECEA1AFS470	CAP,E 47UF/10V
C1022	ECKF1H103ZF	CAP,C .01UF–Z–50V
C1801	ECEA1HKA010	CAP,E 1.0UF/50V
C1802	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C1803	ECEA1HKA010	CAP,E 1.0UF/50V
C1805	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C1806	ECEA1CKA100	CAP,E 10UF/16V
C1807	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C1808	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C1809	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C1810	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C1811	ECEA1EKA4R7	CAP,E 4.7UF/25V
C1812	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C1813	ECEA0JKA331Q	CAP,E 330UF/6.3V
C1814	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C1820	ECUX1H390JCX	CAP,C 39PF–J–50V
C1837	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C1838	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C2130	ECA1CM102GB	CAP,E 1000UF/16V
C2131	ECA1CM331GB	CAP,E 330/16V
C2132	ECA1CM100GB	CAP,E 10/16V

REPLACEMENT PARTS LIST

(Models: CT–27G30T, CT–31G30T, CT–27G30C, CT–27G30UT, CT–31G30UT)

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION
C2133	ECA1HMR47GB	CAP,E .47UF/50V
C2137	ECQB1H104JF	CAP,P .1UF–J–50V
C2138	ECA0JM101GB	CAP,E 100UF/6.3V
C2139	ECKF1H101KB	CAP,C 100PF–K–50V
C2140	ECKF1H101KB	CAP,C 100PF–K–50V
C2141	ECKF1H101KB	CAP,C 100PF–K–50V
C2142	ECA1HM330GB	CAP,E 33/50V
C2201	ECEA1EU4R7	CAP,E 4.7UF/25V
C2202	ECEA1EU4R7	CAP,E 4.7UF/25V
C2203	ECEA1EU4R7	CAP,E 4.7UF/25V
C2204	ECQB1H104JF	CAP,P .1UF–J–50V
C2205	ECEA1HUR68	CAP,E .68UF/50V
C2206	ECEA1CU101	CAP,E 100UF/16V
C2207	ECEA1EU4R7	CAP,E 4.7UF/25V
C2208	ECEA1EU4R7	CAP,E 4.7UF/25V
C2209	AP106K016CAE	CAP,T 10UF/16V
C2210	ECQB1H104KF	CAP,P .1UF–K–50V
C2211	AP335K016CAE	CAP,T 3.3UF/16V
C2212	ECEA1HU010	CAP,E 1UF/50V
C2213	ECEA1HFSR47	CAP,E .47UF/50V
C2214	ECEA1EU4R7	CAP,E 4.7UF/25V
C2215	ECQB1H104KF	CAP,P .1UF–K–50V
C2216	ECUX1H102JCX	CAP,C .001UF–J–50V
C2217	ECQB1H683JF	CAP,P .068UF–J–50V
C2218	ECUX1H222KBX	CAP,C .0022UF–K–50V
C2219	ECUX1H103KBX	CAP,C .01UF–K–50V
C2220	ECEA1EU4R7	CAP,E 4.7UF/25V
C2301	ECA1EM101GB	CAP,E 100/25V
C2302	ECA1HM010GB	CAP,E 1.0UF/50V
C2303	ECKF1H392KB	CAP,C .0039–K–50V
C2304	ECKF1H392KB	CAP,C .0039–K–50V
C2305	ECA1HM010GB	CAP,E 1.0UF/50V
C2306	ECA1EM101GB	CAP,E 100/25V
C2307	ECA1CM102GB	CAP,E 1000UF/16V
C2308	ECEA1EN470U	CAP,E 47UF/25V
C2309	ECQB1H104KF	CAP,P .1UF–K–50V
C2310	ECQB1H104KF	CAP,P .1UF–K–50V
C2311	ECEA1EN470U	CAP,E 47UF/25V
C2312	ECA1CM102GB	CAP,E 1000UF/16V
C2313	ECA1EM102GB	CAP,E 1000UF/25V
C2315	ECA1EM100GB	CAP,E 10UF/25V
C2316	ECA1EM101GB	CAP,E 100/25V
C2318	ECKF1H332KB	CAP,C .0033UF–K–50V
C2319	ECKF1H332KB	CAP,C .0033UF–K–50V
C2320	ECA1AM222GE	CAP,E 2200UF/10V
C2321	ECA1HM010GB	CAP,E 1.0UF/50V
C2322	ECA1CM100GB	CAP,E 10/16V
C2323	ECUX1H103KBX	CAP,C .01UF–K–50V
C2324	ECQB1H683KF	CAP,P .068UF–K–50V
C2325	ECEA1HN3R3S	CAP,E 3.3UF/50V
C2326	ECEA1HN3R3S	CAP,E 3.3UF/50V
C2327	ECUX1H103KBX	CAP,C .01UF–K–50V
C2328	ECQB1H683KF	CAP,P .068UF–K–50V
C2340	ECA1CM100GB	CAP,E 10/16V
C2341	ECA1CM100GB	CAP,E 10/16V
C2342	ECA1HM010GB	CAP,E 1.0UF/50V
C2343	ECA1HM010GB	CAP,E 1.0UF/50V
C2344	ECA1CM221GB	CAP,E 220/16V
C2403	ECA1CM470GB	CAP,E 47UF/16V
C2404	ECA1HM010GB	CAP,E 1.0UF/50V
C2405	ECA1CM100GB	CAP,E 10/16V
C2406	ECQB1H823KF	CAP,P .082UF–K–50V
C2407	ECQB1H104KF	CAP,P .1UF–K–50V
C2408	ECUX1H222KBX	CAP,C .0022UF–K–50V
C2409	ECUX1H223KBX	CAP,C .022UF–K–50V
C2410	ECUX1H223KBX	CAP,C .022UF–K–50V
C2451	ECEA1HN010S	CAP,E 1UF/50V
C2452	ECEA1HN010S	CAP,E 1UF/50V
C2453	ECA1HM4R7GB	CAP,E 4.7UF/50V
C2455	ECA1CM100GB	CAP,E 10/16V
C2456	ECA1CM100GB	CAP,E 10/16V
C2457	ECA1HM4R7GB	CAP,E 4.7UF/50V
C2458	ECA1HM4R7GB	CAP,E 4.7UF/50V
C3001	ECA1HM010GB	CAP,E 1.0UF/50V
C3002	ECA1HM010GB	CAP,E 1.0UF/50V
C3003	ECA1CM100GB	CAP,E 10/16V
C3004	ECA1AM220GB	CAP,E 22UF/10V
C3005	ECA1AM220GB	CAP,E 22UF/10V
C3006	ECA1CM470GB	CAP,E 47UF/16V
C3007	ECUX1H103KBX	CAP,C .01UF–K–50V
C3008	ECUX1H151JCX	CAP,C 150PF–J–50V
C3031	ECA1CM100GB	CAP,E 10/16V
C3032	ECA1CM100GB	CAP,E 10/16V
C3033	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C3034	ECA1HM010GB	CAP,E 1.0UF/50V
C3035	ECA1HM010GB	CAP,E 1.0UF/50V
C3036	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C3071	ECA1CM220GB	CAP,E 22UF/16V
C3072	ECUX1H103KBX	CAP,C .01UF–K–50V
C3201	ECA1AM470GB	CAP,E 47UF/10V
C3202	ECQB1H473KF	CAP,P .047UF–K–50V
C3203	ECUX1H103KBX	CAP,C .01UF–K–50V
C3204	ECUX1H103KBX	CAP,C .01UF–K–50V
C3206	ECEA1AN220S	CAP,E 22UF/10V
C3207	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C3208	ECUX1H101JCX	CAP,C 100PF–J–50V
C3209	ECUX1H121JCX	CAP,C 120PF–J–50V
C3212	ECUX1H390JCX	CAP,C 39PF–J–50V
C4353	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C4354	ECEA1CKA220	CAP,E 22UF/16V
C4355	ECEA1CKA100	CAP,E 10UF/16V
C4356	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C4357	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C4358	ECA0JM331GB	CAP,E 330UF/10V
C4359	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C4360	ECEA1CKA220	CAP,E 22UF/16V
C4361	ECEA1HKA2R2	CAP,E 2.2UF/50V
C4362	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C4363	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C4364	ECEA1HKA3R3	CAP,E 3.3UF/50V
C4365	ECEA1HKAR47	CAP,E .47UF/50V
C4367	ECUX1H103ZFX	CAP,C .01UF–Z–50V

REPLACEMENT PARTS LIST

(Models: CT–27G30T, CT–31G30T, CT–27G30C, CT–27G30UT, CT–31G30UT)

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION
C4368	ECUX1H681KBX	CAP,C 680PF–K–50V
C4369	ECEA1HKAR47	CAP,E .47UF/50V
C4370	ECUX1H391KBX	CAP,C 390PF–K–50V
C4371	ECEA1HKA010	CAP,E 1.0UF/50V
C4374	ECUX1H122JCX	CAP,C .0012UF–J–50V
C4375	ECEA1HKA010	CAP,E 1.0UF/50V
C4380	ECRHA030E81	TRIMMER: 30PF
C4390	ECA0JM331GB	CAP,E 330UF/10V
C4407	ECUX1H103ZFX	CAP,C .01UF–Z–50V
C4408	ECUX1H101JCX	CAP,C 100PF–J–50V
C4411	ECEA1CKA100	CAP,E 10UF/16V
C4412	ECEA1CKN100	CAP,E 10UF/16V
C4414	ECEA1CKN100	CAP,E 10UF/16V
C4415	ECEA1CKA100	CAP,E 10UF/16V
C4416	ECEA1CKA100	CAP,E 10UF/16V
C4420	ECUX1H820JCX	CAP,C 82PF–J–50V
		DIODES
D001	ERA15–01	DIODE
D002	MA167	DIODE
D003	MA4047	DIODE, ZENER
D004	MA4062M	DIODE, ZENER
D006	MA165	DIODE
D022	MA165	DIODE
D025	MA165	DIODE
D301	MA165	DIODE
D303	MA165	DIODE
D352	MA4062L	DIODE, ZENER
D353	MA4062L	DIODE, ZENER
D355	MA4062L	DIODE, ZENER
D451	ERA15–01	DIODE
D452	MA150	DIODE
D453	MA165	DIODE
D454	MA4120M	DIODE
D455	MA4110H	DIODE, ZENER
D456	MA165	DIODE
D501	MA4082L	DIODE
D531	**AS01**	**DIODE**
D532	**MA4062L**	**DIODE, ZENER**
D542	MA4051M	DIODE, ZENER
D551	MA165	DIODE
D553	MA165	DIODE
D554	**AS01**	**DIODE**
D555	MA165	DIODE
D556	MA4360H	DIODE, ZENER
D557	MA2051	DIODE
D558	**RS3FS**	**DIODE**
D559	**TVSRU3M**	**DIODE**
D801	**TVSRM11B**	**DIODE**
D802	**TVSRM11B**	**DIODE**
D803	**TVSRM11B**	**DIODE**
D804	**TVSRM11B**	**DIODE**
D805	**TRPW5B0M030D**	**THERMISTOR CT–31G30TM CT–31G30UTM**
D805	**TRPW5B0M050D**	**THERMISTOR CT–27G30TM CT–27G30CTC CT–27G30UTM**
D806	BYD33M–113	DIODE
D807	MA1075L	DIODE
D808	AU01	DIODE
D809	**RU30ALFS1**	**DIODE**
D810	**RU3YX–M**	**DIODE**
D811	**RU3YX–MLF–C2**	**DIODE**
D812	**AU02**	**DIODE**
D1801	MA151K	DIODE
D2110	MA4300H	DIODE
D3001	MA165	DIODE
D3002	MA165	DIODE
D3005	MA3110M	DIODE
D3075	MA3110M	DIODE
D3076	MA3110M	DIODE
D3077	MA3110M	DIODE
D3078	MA3110M	DIODE
D3079	MA3110M	DIODE
D3082	MA3110M	DIODE
D3083	MA3110M	DIODE
D4420	MA3110	DIODE
		FUSES
F001	**XBA1C40NU100**	**FUSE 4.0A/125V**
		INTEGRATED CIRCUITS
IC001	MN1873234HYJ	INT CKT
IC002	24LC02BIP	ROM
IC101	**AN5163K**	**INT CKT**
IC451	**LA7836–TV**	**INT CKT**
IC551	**AN7809**	**INT CKT**
IC552	AN78M05	PLUS 5V AVR
IC553	AN78L12	INT CKT
IC801	**STK730–020**	**INT CKT**
IC1801	M65607SP	INT CKT
IC1802	MN47464L–12	INT CKT
IC1803	M52694P	PIP PROCESSER
IC1804	MN1280R	INT CKT
IC2201	AN5817NF	MTS IC
IC2301	AN7147N	INT CKT
IC2302	CXA1279AS	INT CKT
IC2340	BA15218N	INT CKT
IC2401	UPC1891ACY	INT CKT
IC2402	MC14066BCP	INT CKT
IC2451	AN5285K	SOUND AI
IC3001	M52055P	INT CKT
IC3031	M52055P	INT CKT
IC4402	M52055P	INT CKT
		COILS
DEG	0LK19036–1A	COIL, DEGAUSSING CT–31G30TM CT–31G30UTM
DEG	0LK19045A	COIL, DEGAUSSING 27" CT–27G30TM CT–27G30CTC CT–27G30UTM
DY	0LY15414F	YOKE, DEFLECTION CT–31G30TM CT–31G30UTM
DY	**TLY15525F**	**YOKE, DEFLECTION CT–27G30TM CT–27G30CTC CT–27G30UTM**

REPLACEMENT PARTS LIST

(Models: CT-27G30T, CT-31G30T, CT-27G30C, CT-27G30UT, CT-31G30UT)

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REF. NO.	PART NO.	DESCRIPTION
L001	EXCELSA24	FERRITE BEAD
L002	EXCELSA35	FERRITE BEAD
L003	EXCELSA39	FERRITE BEAD
L004	EXCELDR35	FERRITE BEAD
L005	TLUABTA100K	COIL, PEAKING 10UH
L006	EXCELSA35	FERRITE BEAD
L009	ELESN120KA	COIL, PEAKING 12UH
L011	ELESN1R0KA	COIL, PEAKING 1.0UH
L021	ELESN390KA	COIL, PEAKING 39UH
L101	ELESN150KA	COIL, PEAKING 15UH
L103	EIV7EN041B	COIL, AFT
L105	EIV7EN053B	VCO
L106	TLQ012K205C	COIL, PEAKING 1.2UH
L107	TLQ012K205C	COIL, PEAKING 1.2UH
L108	TLUABTA1R0K	COIL, PEAKING 1.0UH
L109	ELESN1R0KA	COIL, PEAKING 1.0UH
L111	ELESN270KA	COIL, PEAKING 27UH
L201	EIS7ES004B	COIL, QUADRATURE
L351	TLUABTA151K	COIL, PEAKING 150UH
L352	EXCELSA24	FERRITE BEAD
L353	EXCELSA24	FERRITE BEAD
L354	EXCELDR25C	FERRITE BEAD
L551	**TLH6621P**	**COIL, LINEARITY**
		CT-27G30TM CT-27G30CTC
		CT-27G30UTM
L551	**TLH6663P**	**COIL, LINEARITY**
		CT-31G30TM CT-31G30UTM
L552	EXCELSA24	FERRITE BEAD
L553	EXCELSA24	FERRITE BEAD
L557	0SC9002	FERRITE BEAD
L558	EXCELSA24	FERRITE BEAD
L559	EXCELSA35	FERRITE BEAD
L563	ELEIN330KA	COIL, 33UH
L571	ELEIN680KA	COIL
L601	ELESN100KA	COIL, PEAKING 10UH
L751	**TLH15727**	**REACTOR, PINCUSHION**
		CT-31G30TM CT-31G30UTM
L801	**ELF18D666A**	**LINE FILTER**
L802	ELEIN330KA	COIL, 33UH
L803	EXCELSA39	FERRITE BEAD
L804	EXCELSA39	FERRITE BEAD
L805	0SC9002	FERRITE BEAD
L806	EXCELSA35	FERRITE BEAD
L807	0SC9002	FERRITE BEAD
L808	0SC9002	FERRITE BEAD
L809	0SC9002	FERRITE BEAD
L810	EXCELSA24	FERRITE BEAD
L811	EXCELSA35	FERRITE BEAD
L813	0SC9002	FERRITE BEAD
L814	0SC9002	FERRITE BEAD
L815	0SC9002	FERRITE BEAD
L816	0SC9002	FERRITE BEAD
L819	EXCELSA35	FERRITE BEAD
L1802	ELESN100KA	COIL, PEAKING 10UH
L1803	ELESN4R7KA	COIL
L2110	ELESN120KA	COIL, PEAKING 12UH
L2111	ELESN120KA	COIL, PEAKING 12UH
L3001	ELESN100KA	COIL, PEAKING 10UH
L3201	EFDEN645B35B	DELAY LINE
L3202	EIK1EG024B	CHROMA TRAP
L3203	ELESN180KA	COIL, PEAKING 18UH
L3204	ELESN100KA	COIL, PEAKING 10UH
L4351	ELESN2R2KA	COIL, PEAKING 2.2UH
L4352	ELESN100KA	COIL, PEAKING 10UH
L4353	EXCELDR25C	FERRITE BEAD
L4402	ELESN100KA	COIL, PEAKING 10UH
		TRANSISTORS
Q002	JC501PQ	TRANSISTOR
Q003	JC501PQ	TRANSISTOR
Q004	JA101PQ	TRANSISTOR
Q007	JC501PQ	TRANSISTOR
Q008	JC501PQ	TRANSISTOR
Q015	JA101PQ	TRANSISTOR
Q101	JC501PQ	TRANSISTOR
Q103	JC501PQ	TRANSISTOR
Q305	JA101PQ	TRANSISTOR
Q306	JC501PQ	TRANSISTOR
Q307	JC501PQ	TRANSISTOR
Q351	2SC3063	TRANSISTOR
Q352	2SC3063	TRANSISTOR
Q353	2SC3063	TRANSISTOR
Q451	JC501PQ	TRANSISTOR
Q452	JC501PQ	TRANSISTOR
Q501	2SC4212H	TRANSISTOR
Q531	JC501PQ	TRANSISTOR
Q541	JC501PQ	TRANSISTOR
Q551	**BU2508DF**	**TRANSISTOR**
Q751	2SD637QRS	TRANSISTOR
		CT-31G30TM CT-31G30UTM
Q752	2SB642QRS	TRANSISTOR
		CT-31G30TM CT-31G30UTM
Q753	**2SD1266**	**TRANSISTOR**
		CT-31G30TM CT-31G30UTM
Q2301	JC501PQ	TRANSISTOR
Q2302	JA101PQ	TRANSISTOR
Q2401	MSD601R	TRANSISTOR
Q2402	MSD601R	TRANSISTOR
Q3007	MSB709-RTI	TRANSISTOR
Q3071	MSD601R	TRANSISTOR
Q3072	MSD601R	TRANSISTOR
Q3073	MSD601R	TRANSISTOR
Q3201	MSD601R	TRANSISTOR
Q3202	MSD601R	TRANSISTOR
Q3203	MSD601R	TRANSISTOR
Q3204	MSD601R	TRANSISTOR
Q3205	MSD601R	TRANSISTOR
Q3206	MSD601R	TRANSISTOR
Q4351	MSB709R	TRANSISTOR
Q4354	MSB709R	TRANSISTOR
Q4355	MSB709R	TRANSISTOR
Q4356	MSB709R	TRANSISTOR
Q4357	MSD601R	TRANSISTOR

REPLACEMENT PARTS LIST

(Models: CT–27G30T, CT–31G30T, CT–27G30C, CT–27G30UT, CT–31G30UT)

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REF. NO.	PART NO.	DESCRIPTION
Q4358	MSB709R	TRANSISTOR
Q4360	MSD601R	TRANSISTOR
Q4361	MSD601R	TRANSISTOR
Q4362	MSD601R	TRANSISTOR
Q4363	MSD601R	TRANSISTOR
Q4366	MSD601R	TRANSISTOR
Q4369	MSB709R	TRANSISTOR
Q4370	MSB709R	TRANSISTOR
Q4371	MSD601R	TRANSISTOR
Q4401	MSB709R	TRANSISTOR
		RELAYS
RL001	**TSE1860–1**	**RELAY**
		RESISTORS
R002	ERD25TJ103	RES,C 10K–J–1/4
R003	ERDS2TJ562	RES,C 5.6K–J–1/4
R004	ERD25TJ331	RES,C 330–J–1/4
R005	ERDS2TJ101	RES,C 100–J–1/4
R006	ERD25TJ102	RES,C 1K–J–1/4
R007	ERD25TJ102	RES,C 1K–J–1/4
R008	ERDS2TJ182	RES,C 1.8K–J–1/4
R009	ERD25TJ101	RES,C 100–J–1/4
R013	ERDS2TJ473	RES,C 47K–J–1/4
R017	ERD25TJ102	RES,C 1K–J–1/4
R018	ERDS2TJ472	RES,C 4.7K–J–1/4
R019	ERDS2TJ472	RES,C 4.7K–J–1/4
R020	ERDS2TJ474	RES,C 470K–J–1/4
R021	ERDS2TJ101	RES,C 100–J–1/4
R022	ERDS2TJ101	RES,C 100–J–1/4
R023	ERDS2TJ101	RES,C 100–J–1/4
R024	ERD25TJ101	RES,C 100–J–1/4
R025	ERD25TJ101	RES,C 100–J–1/4
R026	ERD25TJ102	RES,C 1K–J–1/4
R030	ERD25TJ683	RES,C 68K–J–1/4
R031	ERDS2TJ823	RES,C 82K–J–1/4
R036	ERD25TJ181	RES,C 180–J–1/4
R037	ERDS2TJ752	RES,C 7.5K–J–1/4
R038	ERDS2TJ822	RES,C 8.2K–J–1/4
R039	ERDS2TJ333	RES,C 33K–J–1/4
R040	ERDS2TJ822	RES,C 8.2K–J–1/4
R042	ERDS2TJ203	RES,C 20K–J–1/4
R043	ERDS2TJ473	RES,C 47K–J–1/4
R044	ERDS2TJ473	RES,C 47K–J–1/4
R045	ERDS2TJ103	RES,C 10K–J–1/4
R046	ERDS2TJ182	RES,C 1.8K–J–1/4
R050	EROS2TKF1002	RES,M 10K–F–1/4 CT–31G30TM CT–31G30UTM
R050	ER0S2CKF1002	RES,M 10K–F–1/4 CT–27G30TM CT–27G30CTC CT–27G30UTM
R054	ERD25TJ102	RES,C 1K–J–1/4
R055	ERDS1FJ330	RES,C 33–J–1/2
R056	ERD25TJ102	RES,C 1K–J–1/4
R058	ERDS2TJ272	RES,C 2.7K–J–1/4
R059	ERDS2TJ222	RES,C 2.2K–J–1/4
R060	ERDS2TJ332	RES,C 3.3K–J–1/4
R061	ERDS2TJ562	RES,C 5.6K–J–1/4
R062	ERDS2TJ103	RES,C 10K–J–1/4
R063	ERDS2TJ273	RES,C 27K–J–1/4
R065	ERDS2TJ101	RES,C 100–J–1/4
R067	ERD25TJ102	RES,C 1K–J–1/4
R070	ERDS1TJ183	RES,C 18K–J–1/2
R071	ERD25TJ101	RES,C 100–J–1/4
R072	ERD25TJ101	RES,C 100–J–1/4
R074	ERDS1TJ183	RES,C 18K–J–1/2
R075	ERDS2TJ103	RES,C 10K–J–1/4
R078	ERG3ANJ103	RES,M 1OK–J–3W
R080	ERDS2TJ391	RES,C 390–J–1/4
R081	ERDS2TJ122	RES,C 1.2K–J–1/4
R082	ERD25TJ103	RES,C 10K–J–1/4
R083	ERDS2TJ103	RES,C 10K–J–1/4
R084	ERDS1TJ472	RES,C 4.7K–J–1/2
R085	ERDS2TJ334	RES,C 330K–J–1/4
R086	ERDS2TJ684	RES,C 680K–J–1/4
R088	ERDS2TJ223	RES,C 22K–J–1/4
R089	ERDS2TJ302	RES,C 3K–J–1/4
R091	ERDS2TJ272	RES,C 2.7K–J–1/4
R092	ERDS2TJ223	RES,C 22K–J–1/4
R093	ERDS2TJ103	RES,C 10K–J–1/4
R094	ERDS2TJ393	RES,C 39K–J–1/4
R102	ERDS2TJ683	RES,C 68K–J–1/4
R103	ERDS2TJ183	RES,C 18K–J–1/4
R104	ERDS2TJ121	RES,C 120–J–1/4
R105	ERDS2TJ102	RES,C 1K–J–1/4
R106	EVND2AA03B14	CONTROL 10K
R107	ERDS2TJ222	RES,C 2.2K–J–1/4
R111	ERDS2TJ361	RES,C 360–J–1/4
R112	ERDS2TJ561	RES,C 560–J–1/4
R113	ERDS2TJ473	RES,C 47K–J–1/4
R114	ERDS2TJ104	RES,C 100K–J–1/4
R115	ERD25TJ221	RES,C 220–J–1/4
R152	ERDS2TJ154	RES,C 150K–J–1/4
R201	ERDS2TJ221	RES,C 220–J–1/4
R202	ERDS2TJ682	RES,C 6.8K–J–1/4
R203	ERDS2TJ392	RES,C 3.9K–J–1/4
R204	ERD25TJ472	RES,C 4.7K–J–1/4
R301	ERDS2TJ153	RES,C 15K–J–1/4
R302	ERDS2TJ682	RES,C 6.8K–J–1/4
R304	ERDS2TJ274	RES,C 270K–J–1/4
R305	ERDS2TJ102	RES,C 1K–J–1/4
R306	ERDS2TJ102	RES,C 1K–J–1/4
R307	ERD25TJ472	RES,C 4.7K–J–1/4
R313	ERDS2TJ471	RES,C 470–J–1/4
R317	ERDS2TJ221	RES,C 220–J–1/4
R319	ERDS2TJ471	RES,C 470–J–1/4
R324	ERDS2TJ331	RES,C 330–J–1/4
R325	ERDS2TJ222	RES,C 2.2K–J–1/4
R326	ERDS2TJ471	RES,C 470–J–1/4
R327	ERDS2TJ682	RES,C 6.8K–J–1/4
R328	ERDS2TJ332	RES,C 3.3K–J–1/4
R332	ERDS2TJ273	RES,C 27K–J–1/4
R339	ERD25TJ514	RES,C 510K–J–1/4
R351	ERG2ANJ123	RES,M 12K–J–2W

REPLACEMENT PARTS LIST

(Models: CT–27G30T, CT–31G30T, CT–27G30C, CT–27G30UT, CT–31G30UT)

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REF. NO.	PART NO.	DESCRIPTION
R352	ERG2ANJ123	RES,M 12K–J–2W
R353	ERG2ANJ123	RES,M 12K–J–2W
R354	ERDS1TJ272	RES,C 2.7K–J–1/2
R355	ERDS1TJ272	RES,C 2.7K–J–1/2
R356	ERDS1TJ272	RES,C 2.7K–J–1/2
R357	ERDS2TJ241	RES,C 240–J–1/4
		CT–31G30TM CT–31G30UTM
R357	ERDS2TJ271	RES,C 270–J–1/4
		CT–27G30TM CT–27G30CTC
		CT–27G30UTM
R358	ERDS2TJ241	RES,C 240–J–1/4
		CT–31G30TM CT–31G30UTM
R358	ERDS2TJ271	RES,C 270–J–1/4
		CT–27G30TM CT–27G30CTC
		CT–27G30UTM
R359	ERDS2TJ241	RES,C 240–J–1/4
		CT–31G30TM CT–31G30UTM
R359	ERDS2TJ271	RES,C 270–J–1/4
		CT–27G30TM CT–27G30CTC
		CT–27G30UTM
R360	ERDS2TJ152	RES,C 1.5K–J–1/4
R361	ERDS2TJ152	RES,C 1.5K–J–1/4
R362	ERDS2TJ152	RES,C 1.5K–J–1/4
R364	ERDS2TJ101	RES,C 100–J–1/4
R365	ERDS2TJ101	RES,C 100–J–1/4
R366	ERDS2TJ101	RES,C 100–J–1/4
R401	ERDS2TJ224	RES,C 220K–J–1/4
R402	ERDS2TJ561	RES,C 560–J–1/4
R404	ERDS2TJ221	RES,C 220–J–1/4
R451	ERDS2TJ471	RES,C 470–J–1/4
R452	ERD25TJ473	RES,C 47K–J–1/4
R453	EVND2AA03B34	CONTROL 30K
R454	ERX1ANJ1R0	RES,M 1.0–J–1W
		CT–27G30TM CT–27G30CTC
		CT–27G30UTM
R454	ERX1ANJ1R2	RES,M 1.2–J–1W
		CT–31G30TM CT–31G30UTM
R455	ERDS2TJ333	RES,C 33K–J–1/4
R456	ERDS2TJ273	RES,C 27K–J–1/4
R457	ERDS2TJ102	RES,C 1K–J–1/4
		CT–31G30TM CT–31G30UTM
R457	ERDS2TJ681	RES,C 680–J–1/4
		CT–27G30TM CT–27G30CTC
		CT–27G30UTM
R458	ERDS2TJ223	RES,C 22K–J–1/4
R459	ERDS2TJ102	RES,C 1K–J–1/4
R461	ERDS2TJ102	RES,C 1K–J–1/4
R462	ERDS2TJ473	RES,C 47K–J–1/4
R463	ERDS2TJ224	RES,C 220K–J–1/4
R464	ERDS2TJ124	RES,C 120K–J–1/4
R465	ERDS1FJ1R5	RES,C 1.5–J–1/2
R466	ERDS2TJ101	RES,C 100–J–1/4
R467	ERDS2TJ102	RES,C 1K–J–1/4
R470	ERDS2TJ153	RES,C 15K–J–1/4
R471	ERDS2TJ271	RES,C 270–J–1/4
R472	ERDS2TJ103	RES,C 10K–J–1/4

REF. NO.	PART NO.	DESCRIPTION
R501	ERDS2TJ102	RES,C 1K–J–1/4
R502	ERDS2TJ332	RES,C 3.3K–J–1/4
R503	ERDS2TJ182	RES,C 1.8K–J–1/4
R504	ERD25TJ561	RES,C 560–J–1/4
R505	ERDS2TJ561	RES,C 560–J–1/4
R506	ERDS2TJ100	RES,C 10–J–1/4
R507	ERDS2TJ562	RES,C 5.6K–J–1/4
R508	ERDS2TJ562	RES,C 5.6K–J–1/4
R509	ERG2ANJ562	RES,M 5.6K–J–2W
R510	**ERG3ANJ242**	**RES,M 24K–J–3W**
		CT–31G30TM CT–31G30UTM
R510	**ERG3ANJ392**	**RES,M 3.9K–J–3W**
		CT–27G30TM CT–27G30CTC
		CT–27G30UTM
R511	**ERG3ANJ242**	**RES,M 24K–J–3W**
		CT–31G30TM CT–31G30UTM
R511	**ERG3ANJ332**	**RES,M 3.3K–J–3W**
		CT–27G30TM CT–27G30CTC
		CT–27G30UTM
R516	ERD25TJ681	RES,C 680–J–1/4
R517	ERDS2TJ224	RES,C 220K–J–1/4
R531	**ERD25FJ470**	**RES,C 47–J–1/4**
R532	**ER0S2CKF5362**	**RES,M 53.6K–F–1/4**
R533	**ER0S2CKF7151**	**RES,M 7.15K–F–1/4**
R534	**ERD25TJ684**	**RES,C 680K–J–1/4**
R538	**ERD25TJ821**	**RES,C 820–J–1/4**
R539	**ERDS2TJ681**	**RES,C 680–J–1/4**
R540	ERD25TJ101	RES,C 100–J–1/4
R541	ERDS2TJ272	RES,C 2.7K–J–1/4
R542	ERDS2TJ121	RES,C 120–J–1/4
R544	ERDS2TJ562	RES,C 5.6K–J–1/4
R546	ERDS2TJ564	RES,C 560K–J–1/4
R547	ERDS2TJ102	RES,C 1K–J–1/4
R548	ERD25TJ394	RES,C 390K–J–1/4
R549	ERDS2TJ332	RES,C 3.3K–J–1/4
R551	ERX2ANJ1R0	RES,M 1.0–J–2W
R552	ERG2ANJ221	RES,M 220–J–2W
R553	ERD25TC0V	JUMPER
R554	ERD25TJ623	RES,C 62K–J–1/4
R555	ERDS2TJ223	RES,C 22K–J–1/4
R556	ERDS2TJ202	RES,C 2K–J–1/4
		CT–31G30TM CT–31G30UTM
R556	ERDS2TJ222	RES,C 2.2K–J–1/4
		CT–27G30TM CT–27G30CTC
		CT–27G30UTM
R557	ERDS2TJ103	RES,C 10K–J–1/4
R558	**ERQ2CJP2R2**	**RES,F 2.2–J–2W**
R559	**ERG3SJ820**	**RES,M 82–J–3W**
R561	ERG2ANJ102	RES,M 1K–J–2W
R563	ERG2ANJ561	RES,M 560–J–2W
R571	ERX1SJ1R0	RES,M 1.0–J–1W
R572	ERG3SJ390	RES,M 39–J–3W
R601	ERDS2TJ152	RES,C 1.5K–J–1/4
R602	ERDS2TJ392	RES,C 3.9K–J–1/4
R604	ERDS2TJ331	RES,C 330–J–1/4
R605	ERDS2TJ331	RES,C 330–J–1/4

REPLACEMENT PARTS LIST

(Models: CT–27G30T, CT–31G30T, CT–27G30C, CT–27G30UT, CT–31G30UT)

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REF. NO.	PART NO.	DESCRIPTION
R606	ERDS2TJ331	RES,C 330–J–1/4
R607	ERD25TJ202	RES,C 2K–J–1/4
R608	ERD25TJ202	RES,C 2K–J–1/4
R609	ERD25TJ202	RES,C 2K–J–1/4
R610	ERD25TJ182	RES,C 1.8K–J–1/4
R611	ERDS2TJ681	RES,C 680–J–1/4
R612	ERDS2TJ681	RES,C 680–J–1/4
R613	ERDS2TJ681	RES,C 680–J–1/4
R614	ERDS2TJ222	RES,C 2.2K–J–1/4
R615	ERDS2TJ222	RES,C 2.2K–J–1/4
R616	ERDS2TJ222	RES,C 2.2K–J–1/4
R617	ERDS2TJ222	RES,C 2.2K–J–1/4
R618	ERDS2TJ392	RES,C 3.9K–J–1/4
R619	ERDS2TJ331	RES,C 330–J–1/4
R752	ERDS2TJ333	RES,C 33K–J–1/4
		CT–31G30TM CT–31G30UTM
R753	ERDS2TJ103	RES,C 10K–J–1/4
		CT–31G30TM CT–31G30UTM
R754	ERQ14AJ221	RES,F 220–J–1/4
		CT–31G30TM CT–31G30UTM
R755	ERDS2TJ563	RES,C 56K–J–1/4
		CT–31G30TM CT–31G30UTM
R756	ERDS2TJ103	RES,C 10K–J–1/4
		CT–31G30TM CT–31G30UTM
R757	ERDS2TJ224	RES,C 220K–J–1/4
		CT–31G30TM CT–31G30UTM
R758	ERDS2TJ273	RES,C 27K–J–1/4
		CT–31G30TM CT–31G30UTM
R759	ERDS2TJ222	RES,C 2.2K–J–1/4
		CT–31G30TM CT–31G30UTM
R760	EVND8AA03B53	CONTROL 5K
		CT–31G30TM CT–31G30UTM
R761	EVND8AA03B14	CONTROL 10K
		CT–31G30TM CT–31G30UTM
R762	ERDS2TJ182	RES,C 1.8K–J–1/4
		CT–31G30TM CT–31G30UTM
R763	ERDS2TJ183	RES,C 18K–J–1/4
		CT–31G30TM CT–31G30UTM
R764	ERDS2TJ124	RES,C 120K–J–1/4
		CT–31G30TM CT–31G30UTM
R765	ERDS2TJ272	RES,C 2.7K–J–1/4
		CT–31G30TM CT–31G30UTM
R766	ERDS2TJ362	RES,C 3.6K–J–1/4
		CT–31G30TM CT–31G30UTM
R767	ERDS2TJ222	RES,C 2.2K–J–1/4
		CT–31G30TM CT–31G30UTM
R768	ERQ2CJP100	RES,F 10–J–2W
		CT–31G30TM CT–31G30UTM
R801	**ERF7ZKR82**	**RES,W .82–K–7W**
R802	**ERC12ZGM825**	**RES,S 8.2MEG–M–1/2**
R804	ERG2ANJ333	RES,M 33K–J–2W
R805	ERF2AKR27	RES,W .27–K–2W
R806	ERDS2TJ273	RES,C 27K–J–1/4
R807	ERDS1FJ132	RES,C 1.3K–J–1/2
R808	ERDS2TJ185	RES,C 1.8MEG–J–1/4
R809	ERDS1TJ101	RES,C 100–J–1/2

REF. NO.	PART NO.	DESCRIPTION
R810	**ERDS1FJ1R0**	**RES,C 1.0–J–1/2**
R811	**ERQ1CKPR33**	**RES,F .33–K–1W**
R812	ERQ2CKP1R2	RES,F 1.2–K–2W
R813	**ERQ2CKR33**	**RES,F .33–K–2W**
R814	ERDS2TJ185	RES,C 1.8MEG–J–1/4
R816	ERDS2TJ105	RES,C 1MEG–J–1/4
R1023	ERD25TJ102	RES,C 1K–J–1/4
R1025	ERDS2TJ103	RES,C 10K–J–1/4
R1029	ERD25TJ102	RES,C 1K–J–1/4
R1030	ERDS2TJ473	RES,C 47K–J–1/4
R1801	ERJ6GEYJ101	RES,M 100–J–1/10
R1802	ERJ6GEYJ101	RES,M 100–J–1/10
R1803	ERJ6GEYJ103	RES,M 10K–J–1/10
R1804	ERJ6GEYJ562	RES,M 5.6K–J–1/10
R1805	ERJ6GEYJ562	RES,M 5.6K–J–1/10
R1806	ERJ6GEYJ750	RES,M 75–J–1/10
R1807	ERJ6GEYJ750	RES,M 75–J–1/10
R1811	ERJ6GEYJ103	RES,M 10K–J–1/10
R1812	ERJ6GEYJ103	RES,M 10K–J–1/10
R1813	ERJ6GEYJ103	RES,M 10K–J–1/10
R1814	EVND8AA03B23	CONTROL 2K
R1815	ERJ6GEYJ473	RES,M 47K–J–1/10
R1816	ERJ6GEYJ473	RES,M 47K–J–1/10
R1817	ERJ6GEYJ683	RES,M 68K–J–1/10
R1818	ERJ6GEYJ562	RES,M 5.6K–J–1/10
R1819	ERJ6GEYJ153	RES,M 15K–J–1/10
R1821	ERJ6GEYJ221	RES,M 220–J–1/10
R1822	ERJ6GEYJ221	RES,M 220–J–1/10
R1823	ERJ6GEYJ221	RES,M 220–J–1/10
R1824	ERJ6GEYJ221	RES,M 220–J–1/10
R1825	ERJ6GEYJ221	RES,M 220–J–1/10
R1826	ERJ6GEYJ221	RES,M 220–J–1/10
R1827	ERJ6GEYJ221	RES,M 220–J–1/10
R1828	ERJ6GEYJ221	RES,M 220–J–1/10
R1830	ERJ6GEYJ221	RES,M 220–J–1/10
R1831	ERJ6GEYJ221	RES,M 220–J–1/10
R1832	ERJ6GEYJ221	RES,M 220–J–1/10
R1833	ERJ6GEYJ221	RES,M 220–J–1/10
R2132	ERDS2TJ221	RES,C 220–J–1/4
R2133	ERDS2TJ221	RES,C 220–J–1/4
R2134	ERDS2TJ221	RES,C 220–J–1/4
R2135	ERDS2TJ221	RES,C 220–J–1/4
R2201	ERJ6GEYJ512	RES,M 5.1K–J–1/10
R2202	ERJ6GEYJ112	RES,M 1.1K–J–1/10
R2203	ERJ6ENF5602	RES,M 56K–F–1/10
R2204	ERJ6GEYJ562	RES,M 5.6K–J–1/10
R2205	ERJ6GEYJ153	RES,M 15K–J–1/10
R2206	ERJ6GEYJ823	RES,M 82K–J–1/10
R2207	ERJ6GEYJ153	RES,M 15K–J–1/10
R2208	ERJ6GEYJ154	RES,M 150K–J–1/10
R2209	EVND8AA03B54	CONTROL 50K
R2210	ERJ6GEYJ134	RES,M 130K–J–1/10
R2211	ERJ6GEYJ154	RES,M 150K–J–1/10
R2212	ERJ6GEYJ302	RES,M 3K–J–1/10
R2213	EVND8AA03B54	CONTROL 50K
R2219	ERJ6GEYJ153	RES,M 15K–J–1/10

REPLACEMENT PARTS LIST

(Models: CT–27G30T, CT–31G30T, CT–27G30C, CT–27G30UT, CT–31G30UT)

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REF. NO.	PART NO.	DESCRIPTION
R2220	EVND8AA03B24	CONTROL 20K
R2221	EVND8AA03B34	CONTROL 30K
R2222	ERJ6GEYJ153	RES,M 15K–J–1/10
R2223	ERJ6GEYJ393	RES,M 39K–J–1/10
R2226	ERJ6GEYJ474	RES,M 470K–J–1/10
R2228	ERD25TJ102	RES,C 1K–J–1/4
R2245	ERD25TJ102	RES,C 1K–J–1/4
R2277	ERDS2TJ101	RES,C 100–J–1/4
R2301	ERDS2TJ102	RES,C 1K–J–1/4
R2302	ERDS2TJ102	RES,C 1K–J–1/4
R2303	ERDS2TJ912	RES,C 9.1K–J–1/4
R2304	ERDS2TJ912	RES,C 9.1K–J–1/4
R2305	ERD25FJ2R2	RES,C 2.2–J–1/4
R2306	ERD25FJ2R2	RES,C 2.2–J–1/4
R2307	ERDS2TJ392	RES,C 3.9K–J–1/4
R2308	ERDS2TJ392	RES,C 3.9K–J–1/4
R2310	ERDS2TJ103	RES,C 10K–J–1/4
R2311	ERDS2TJ103	RES,C 10K–J–1/4
R2312	ERJ6GEYJ184	RES,M 180K–J–1/10
R2313	ERJ6GEYJ563	RES,M 56K–J–1/10
R2315	ERDS2TJ682	RES,C 6.8K–J–1/4
R2316	ERDS2TJ331	RES,C 330–J–1/4
R2317	ERJ6GEYJ184	RES,M 180K–J–1/10
R2340	ERJ6GEYJ332	RES,M 3.3K–J–1/10
R2342	ERJ6GEYJ473	RES,M 47K–J–1/10
R2345	ERJ6GEYJ472	RES,M 4.7K–J–1/10
R2346	ERJ6GEYJ332	RES,M 3.3K–J–1/10
R2348	ERJ6GEYJ473	RES,M 47K–J–1/10
R2349	ERJ6GEYJ472	RES,M 4.7K–J–1/10
R2350	ERJ6GEYJ332	RES,M 3.3K–J–1/10
R2351	ERDS2TJ222	RES,C 2.2K–J–1/4
R2352	ERDS2TJ332	RES,C 3.3K–J–1/4
R2353	ERDS2TJ222	RES,C 2.2K–J–1/4
R2354	ERJ6GEYJ681	RES,M 680–J–1/10
R2401	ERJ6GEYJ392	RES,M 3.9K–J–1/10
R2402	ERJ6GEYJ392	RES,M 3.9K–J–1/10
R2403	ERJ6GEYJ223	RES,M 22K–J–1/10
R2404	ERJ6GEYJ133	RES,M 13K–J–1/10
R2405	ERJ6GEYJ824	RES,M 820K–J–1/10
R2406	ERDS2TJ332	RES,C 3.3K–J–1/4
R2407	ERDS2TJ103	RES,C 10K–J–1/4
R2410	ERD25FJ3R9	RES,C 3.9–J–1/4
R2411	ERDS2TJ103	RES,C 10K–J–1/4
R2412	ERDS2TJ104	RES,C 100K–J–1/4
R2415	ERJ6GEYJ473	RES,M 47K–J–1/10
R2416	ERJ6GEYJ104	RES,M 100K–J–1/10
R2451	ERJ6GEYJ225	RES,M 2.2MEG–J–1/10
R2454	ERJ6GEYJ243	RES,M 24K–J–1/10
R2455	ERJ6GEYJ103	RES,M 10K–J–1/10
R3001	ERDS2TJ102	RES,C 1K–J–1/4
R3002	ERDS2TJ102	RES,C 1K–J–1/4
R3003	ERDS2TJ184	RES,C 180K–J–1/4
R3004	ERDS2TJ184	RES,C 180K–J–1/4
R3005	ERDS2TJ101	RES,C 100–J–1/4
R3006	ERDS2TJ750	RES,C 75–J–1/4
R3007	ERDS2TJ471	RES,C 470–J–1/4
R3008	ERDS2TJ750	RES,C 75–J–1/4
R3009	ERDS2TJ122	RES,C 1.2K–J–1/4
R3010	ERDS2TJ750	RES,C 75–J–1/4
R3011	ERDS2TJ271	RES,C 270–J–1/4
R3012	ERDS2TJ683	RES,C 68K–J–1/4
R3014	ERJ6GEYJ103	RES,M 10K–J–1/10
R3015	ERJ6GEYJ104	RES,M 100K–J–1/10
R3016	ERDS2TJ221	RES,C 220–J–1/4
R3017	ERJ6GEYJ102	RES,M 1K–J–1/10
R3026	ERJ6GEYJ103	RES,M 10K–J–1/10
R3031	ERDS2TJ121	RES,C 120–J–1/4
R3032	ERDS2TJ750	RES,C 75–J–1/4
R3033	ERDS2TJ184	RES,C 180K–J–1/4
R3034	ERDS2TJ102	RES,C 1K–J–1/4
R3035	ERDS2TJ184	RES,C 180K–J–1/4
R3036	ERDS2TJ102	RES,C 1K–J–1/4
R3037	ERJ6GEYJ683	RES,M 68K–J–1/10
R3038	ERJ6GEYJ683	RES,M 68K–J–1/10
R3071	ERJ6GEYJ223	RES,M 22K–J–1/10
R3072	ERJ6GEYJ683	RES,M 68K–J–1/10
R3073	ERJ6GEYJ683	RES,M 68K–J–1/10
R3074	ERJ6GEYJ223	RES,M 22K–J–1/10
R3075	ERJ6GEYJ102	RES,M 1K–J–1/10
R3076	ERJ6GEYJ102	RES,M 1K–J–1/10
R3077	ERJ6GEYJ152	RES,M 1.5K–J–1/10
R3078	ERJ6GEYJ471	RES,M 470–J–1/10
R3201	ERJ6GEYJ103	RES,M 10K–J–1/10
R3202	ERJ6GEYJ223	RES,M 22K–J–1/10
R3203	ERJ6GEYJ101	RES,M 100–J–1/10
R3204	ERJ6GEYJ102	RES,M 1K–J–1/10
R3205	ERJ6GEYJ272	RES,M 2.7K–J–1/10
R3206	ERJ6GEYJ682	RES,M 6.8K–J–1/10
R3207	ERJ6GEYJ103	RES,M 10K–J–1/10
R3208	ERJ6GEYJ102	RES,M 1K–J–1/10
R3209	ERJ6GEYJ102	RES,M 1K–J–1/10
R3210	ERJ6GEYJ103	RES,M 10K–J–1/10
R3211	ERJ6GEYJ181	RES,M 180–J–1/10
R3212	ERJ6GEYJ331	RES,M 330–J–1/10
R3213	ERJ6GEYJ102	RES,M 1K–J–1/10
R3214	ERJ6GEYJ331	RES,M 330–J–1/10
R3215	EVND8AA03B22	CONTROL 200 OHM
R3217	ERJ6GEYJ271	RES,M 270–J–1/10
R3218	ERJ6GEYJ122	RES,M 1.2K–J–1/10
R3220	ERJ6GEYJ221	RES,M 220–J–1/10
R3221	ERJ6GEYJ102	RES,M 1K–J–1/10
R3222	ERJ6GEYJ471	RES,M 470–J–1/10
R3223	ERJ6GEYJ471	RES,M 470–J–1/10
R3224	ERJ6GEYJ471	RES,M 470–J–1/10
R3227	ERJ6GEYJ332	RES,M 3.3K–J–1/10
R3228	ERJ6GEYJ104	RES,M 100K–J–1/10
R3229	ERJ6GEYJ152	RES,M 1.5K–J–1/10
R4356	ERJ6GEYJ561	RES,M 560–J–1/10
R4358	ERJ6GEYJ102	RES,M 1K–J–1/10
R4359	ERJ6GEYJ471	RES,M 470–J–1/10
R4360	ERJ6GEYJ102	RES,M 1K–J–1/10
R4361	ERJ6GEYJ560	RES,M 56–J–1/10

REPLACEMENT PARTS LIST

(Models: CT–27G30T, CT–31G30T, CT–27G30C, CT–27G30UT, CT–31G30UT)

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REF. NO.	PART NO.	DESCRIPTION
R4362	ERJ6GEYJ561	RES,M 560–J–1/10
R4363	ERJ6GEYJ471	RES,M 470–J–1/10
R4364	ERJ6GEYJ102	RES,M 1K–J–1/10
R4365	ERJ6GEYJ683	RES,M 68K–J–1/10
R4367	ERJ6GEYJ331	RES,M 330–J–1/10
R4368	ERJ6GEYJ510	RES,M 51–J–1/10
R4369	ERJ6GEYJ105	RES,M 1.0MEG–J–1/10
R4370	ERJ6GEYJ222	RES,M 2.2K–J–1/10
R4371	ERJ6GEYJ102	RES,M 1K–J–1/10
R4372	ERJ6GEYJ471	RES,M 470–J–1/10
R4373	ERJ6GEYJ822	RES,M 8.2K–J–1/10
R4374	ERJ6GEYJ273	RES,M 27K–J–1/10
R4375	ERJ6GEYJ221	RES,M 220–J–1/10
R4376	ERJ6GEYJ471	RES,M 470–J–1/10
R4377	ERJ6GEYJ223	RES,M 22K–J–1/10
R4378	ERJ6GEYJ562	RES,M 5.6K–J–1/10
R4379	ERJ6GEYJ103	RES,M 10K–J–1/10
R4380	ERJ6GEYJ683	RES,M 68K–J–1/10
R4381	ERJ6GEYJ331	RES,M 330–J–1/10
R4382	ERJ6GEYJ101	RES,M 100–J–1/10
R4383	ERJ6GEYJ471	RES,M 470–J–1/10
R4384	ERJ6GEYJ331	RES,M 330–J–1/10
R4392	ERJ6GEYJ332	RES,M 3.3K–J–1/10
R4395	ERJ6GEYJ102	RES,M 1K–J–1/10
R4396	ERJ6GEYJ471	RES,M 470–J–1/10
R4397	ERJ6GEYJ393	RES,M 39K–J–1/10
R4398	ERJ6GEYJ334	RES,M 330K–J–1/10
R4399	ERJ6GEYJ272	RES,M 2.7K–J–1/10
R4411	ERJ6GEYJ101	RES,M 100–J–1/10
R4413	ERJ6GEYJ101	RES,M 100–J–1/10
R4414	ERJ6GEYJ101	RES,M 100–J–1/10
R4415	ERJ6GEYJ101	RES,M 100–J–1/10
R4417	ERJ6GEYJ101	RES,M 100–J–1/10
R4418	ERJ6GEYJ101	RES,M 100–J–1/10
R4419	ERJ6GEYJ101	RES,M 100–J–1/10
R4423	ERJ6GEYJ473	RES,M 47K–J–1/10
R4424	ERJ6GEYJ473	RES,M 47K–J–1/10
R4426	ERJ6GEYJ561	RES,M 560–J–1/10
R4427	ERJ6GEYJ223	RES,M 22K–J–1/10
R4428	ERJ6GEYJ222	RES,M 2.2K–J–1/10
R4441	ERJ6GEYJ101	RES,M 100–J–1/10
R4442	ERJ6GEYJ102	RES,M 1K–J–1/10
		SWITCHES
S001	EVQQBH06T	SWITCH, PUSH
S002	EVQQBH06T	SWITCH, PUSH
S003	EVQQBH06T	SWITCH, PUSH
S004	EVQQBH06T	SWITCH, PUSH
S005	EVQQBH06T	SWITCH, PUSH
S006	EVQQBH06T	SWITCH, PUSH
S007	EVQQBH06T	SWITCH, PUSH
		TRANSFORMERS
T001	**TLP16297**	**TRANSFORMER, POWER SUPPLY**
T501	**TLH15452**	**TRANSFORMER, HORIZONTAL DRIVER**
T551	**0LF04508F**	**TRANSFORMER, FLYBACK**
T801	**ETS39AG115AC**	**TRANSFORMER, POWER**

REF. NO.	PART NO.	DESCRIPTION
		CRYSTALS/FILTERS
X001	TSS2080MX	CRYSTAL, 12 MHZ CLOCK
X101	EFCH45MVK12N	SAW FILTER
X102	EFCWS4504AB	FILTER, CERAP
X201	EFCS4R5MS4W	FILTER 4.5MHZ BANDPASS
X501	EF0A503KS41	CRYSTAL, 503KHZ OSCILLATOR
X601	TS816M32	CRYSTAL 3.58MHZ OSCILLATOR
X4351	TSS2163–M	CRYSTAL, 14.3MHZ OSCILLATOR
		OTHERS
RM001	RPM–637CBRS	RECEIVER, REMOTE CONTROL
TNR001	ENV568N6G3	TUNER
TNR002	ENG26205G	U/V TUNER
M001	ENPE620	ANTENNA UNIT
M002	EUR501232	TRANSMITTER
M003	**M68LGL061X**	**CRT 27"**
		CT–27G30TM CT–27G30CTC
		CT–27G30UTM
M004	**M78JUA069X**	**CRT**
		CT–31G30TM CT–31G30UTM
M005	TBM2A10141	PANASONIC BADGE
M006	TBX2A50251	ASSY, 7 PUSHBUTTON
M007	TES2A20312	SPRING, DAG GROUND
M008	**TJS1A5050**	**CRT SOCKET**
M009	TKP2A11221	SMOKED PANEL
M010	TKY2A3062C	CABT. FRONT 27"
		CT–27G30CTC
M011	TLC2047–2	MAGNET,RINGS:PURITY & STATIC CONV.
M012	TMW2A97121	STRAIN RELIEF: AC LINE CORD
M013	TQB2A0943–1	OWNERS MANUAL
		CT–27G30TM CT–31G30TM
		CT–27G30UTM CT–31G30UTM
M014	TQB2A0971	OWNERS MANUAL
		CT–27G30CTC
M015	**TSX3134X**	**AC LINE CORD**
M016	TXFKU0395SER	ASSY, CABINET BACK
		CT–27G30TM CT–27G30UTM
M017	TXFKY4694SER	ASSY, CABINET FRONT
		CT–27G30TM CT–27G30UTM
M018	TXFKU4194SER	ASSY, CABINET BACK
		CT–27G30CTC
M019	TXFKU0495SER	ASSY, CABINET BACK
		CT–31G30TM CT–31G30UTM
M020	TXFKY4794SER	ASSY, CABINET FRONT
		CT–31G30TM CT–31G30UTM
M021	TXFMK01H55	CONVERGENCE CORRECTOR STRIP
		CT–27G30CTC
M022	TXF3A01ADR	ASSY, DAG GROUND
		CT–27G30TM CT–27G30CTC
		CT–27G30UTM
M023	TXF3A01AFR	ASSY, DAG GROUND
		CT–31G30TM CT–31G30UTM
M024	0FMK014ZZ	CONVERGENCE CORRECTOR STRIP
		CT–27G30TM CT–31G30TM
		CT–27G30UTM CT–31G30UTM
JK3031	TJB18619	AV TERMINAL (2AV VAO)

REPLACEMENT PARTS LIST

(Models: CT–27G30T, CT–31G30T, CT–27G30C, CT–27G30UT, CT–31G30UT)

Important Safety Notice: Components printed in **BOLD TYPE** have special characteristics important for safety. When replacing any of these components use only manufacturer's specified parts.

REF. NO.	PART NO.	DESCRIPTION	REF. NO.	PART NO.	DESCRIPTION
M025	T8A262	SILICONE GREASE – HEAT SINK COMPOUND			

DESCRIPTION OF ABBREVIATIONS GUIDE

RESISTOR			
TYPE		TOLERANCE	
C	Carbon	F	+/– 1%
F	Fuse	J	+/– 5%
M	Metal Oxide	K	+/– 10%
S	Solid	M	+/– 20%
W	Wire Wound	G	+/– 2%

RES, C 270–J–1/4

CAPACITOR			
TYPE		TOLERANCE	
C	Ceramic	C	+/– 0.25pF
E	Electrolytic	D	+/– 0.5pF
P	Polyester	F	+/– 1pF
S	Styrol	J	+/– 5%
T	Tantalum	K	+/– 10%
		L	+/– 15%
		M	+/– 20%
		P	+100% –0%
		Z	+80% –20%

CAP, P .068UF–K–50V

NOTES

NOTES

NOTES

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"MIN".

4. All video and color waveforms taken with a wideband scope and a probe with low capacity (10 to 1). Shape and peak amplitudes may vary depending on type of Oscilloscope used and calibration.

COLOR – Waveforms 4~8
VERTICAL – Waveforms 9~12
HORIZONTAL – Waveforms 13~16
CRT DRIVE – Waveforms 17 & 18
POWER SUPPLY – Waveform 19 ~ 21

Schematic Notes

1. Resistors are carbon 1/4W unless noted otherwise.
2. Capacitors are ceramic 50V unless noted otherwise.
3. Coil value noted is inductance in μH.
4. Test point indicated by ●, Test point but no pin ⚲.
5. Components indicated with ⚠ symbol are critical parts and replacement should be made with manufacture specified replacement parts only.
6. **— (BOLD LINES)** Indicates the route of B+ supply.
7. This schematic diagram is the latest at the time of printing and subject to change without notice.
8. Ground symbol ⏚ indicates **HOT GROUND CONNECTION** and ⫻ indicates COLD GROUND CONNECTION.

NOTE: All other component symbols are used for design engineering purposes.

Voltage Measurements

1. Voltage measurement:
   - AC input to Receiver is 120V. NTSC generator connected to antenna of Receiver. (color bar pattern of 100IRE white and 7.5 IRE black.)
   - All Picture and Audio adjustments set for Normalize.

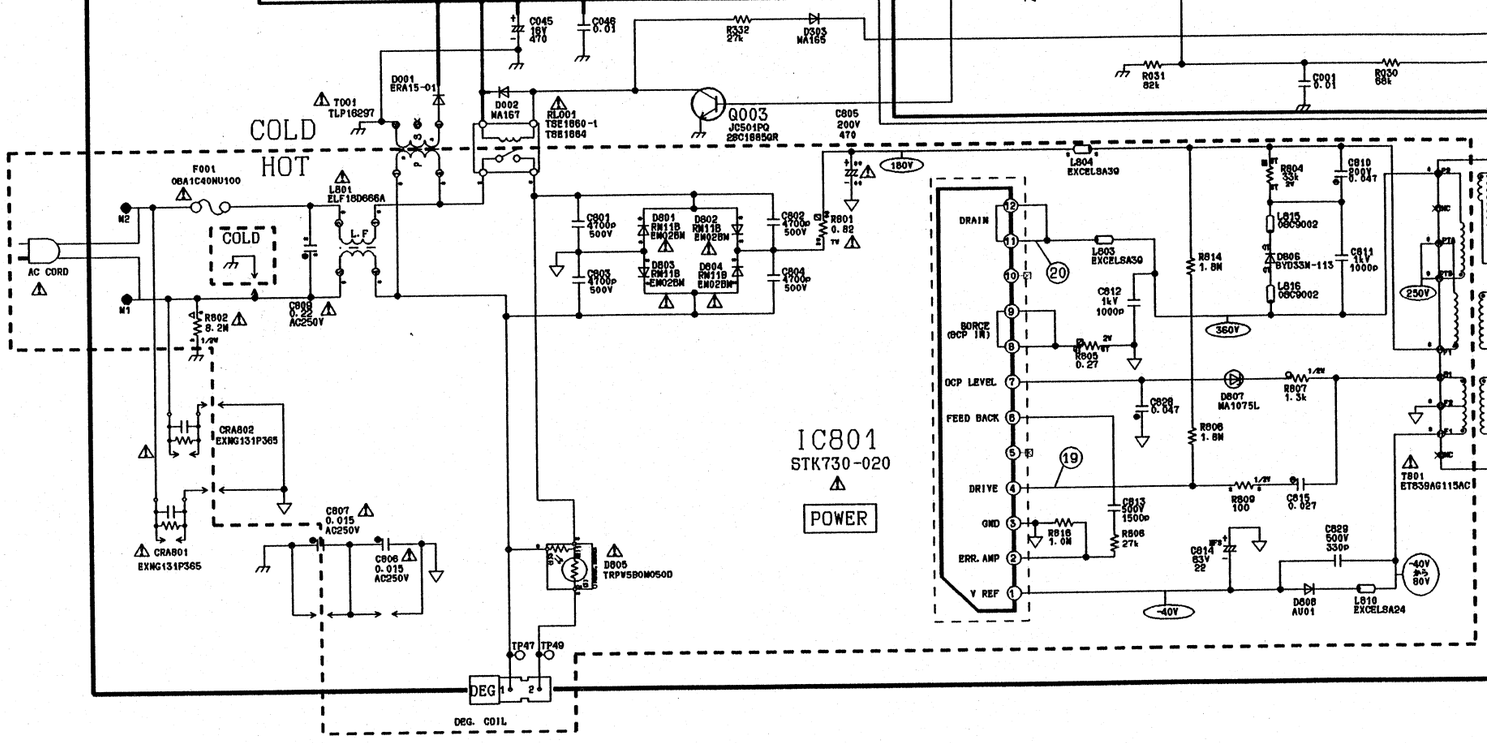
     TV ANT/CABLE – (Set–Up Menu) in TV/ANT Mode

     Volume – Min

     TV/Video SW – TV position

     Audio Mode – Stereo
   - Voltage readings are nominal and may vary ±10% on active devices.

     Some voltage reading will vary with signal strength and picture content.
   - Supply voltages are all nominal.
2. Ground symbol ⏚ indicates ground lead connection of meter. **Caution: Incorrect ground connection will result in erroneous readings.**



Note: Stereo Models

The Functions listed below are activated by a DC voltage change to DAC Inputs (Pin 18 and 19) of MPU IC001. Press and hold a function button on Receiver to take voltage readings.

FUNCTION	PIN 18	PIN 19
POWER	0V~0.6V	0V(Set "OFF")
		0.7V~3.0V (Set "ON")
VOL ◀	0.7V~1.2V	0.7V~3.0V
VOL ▶	1.3V~1.8V	0.7V~3.0V
CH ▼	1.9V~2.4V	0.7V~3.0V
CH ▲	2.6V~3.0V	0.7V~3.0V
TV/VIDEO	3.2V~3.7V	0.7V~3.0V
ACTION	4.6V~5.0V	0V~0.6V

The AUDIO MODES being broadcast are displayed on screen in red by the voltage change to DAC input (Pin 20) of MPU IC001.

AUDIO MODE BROADCAST	PIN 20
MONO	4.0V~5.0V
SAP	2.3V~4.0V
STEREO	1.0V~2.0V
STEREO & SAP	0V~0.9V

Voltage Chart – A–Board (27" Models)

Integrated Circuits (ICs)

IC001

1	5.1	23	0.1	45	2.6
2	3.7	24	4.5	46	0
3	3.9	25	2.6	47	0
4	5.1	26	0	48	0
5	0	27	4.6	49	0
6	5.0	28	4.5	50	5.1
7	5.1	29	0	51	4.9
8	5.1	30	0	52	0
9	5.1	31	4.3		
10	0	32	3.8		
11	0	33	0		
12	0	34	0		
13	3.1	35	0		
14	2.7	36	0		
15	3.0	37	2.3		
16	0.9	38	0		
17	0	39	1.6		
18	5.2	40	1.5		
19	1.9	41	5.2		
20	4.2	42	5.2		
21	2.0	43	5.2		
22	4.1	44	2.6		

IC002

1	0
2	0
3	0
4	0
5	4.5
6	4.5
7	0
8	5.1

IC101

1	2.5	23	4.3	45	6.2
2	1.7	24	2.7	46	2.6
3	3.7	25	4.6	47	4.2
4	0	26	4.0	48	2.1
5	0	27	2.4	49	2.7
6	0	28	0	50	0.8
7	0	29	2.7	51	5.8
8	5.2	30	8.2	52	4.1
9	2.5	31	4.6		
10	2.5	32	2.9		
11	2.5	33	2.4		
12	8.2	34	2.8		
13	2.4	35	1.8		
14	5.8	36	3.0		
15	4.9	37	3.0		
16	4.9	38	5.0		
17	5.0	39	3.5		
18	2.9	40	2.6		
19	3.0	41	0		
20	0	42	2.5		
21	0	43	2.0		
22	2.6	44	0.3		

IC451

1	12.5
2	4.1
3	6.2
4	0
5	6.5
6	5.3
7	26.0
8	2.4
9	1.1
10	0
11	15.0
12	26.6
13	5.3

IC551

1	16.4
2	0
3	8.8

IC552

1	12.5
2	0
3	5.0

IC553

1	16.4
2	12.0
3	0

IC801 ⏚

1	– 39.5
2	– 32.8
3	0
4	– 0.1
5	1.7
6	1.5
7	– 0.3
8	0.3
9	0.3
10	NC
11	VARIES 141~154
12	VARIES 141~154

IC2301

1	1.2
2	0
3	18.1
4	0
5	0
6	1.2
7	9.7
8	17.2
9	0
10	18.3
11	17.2
12	9.4

Transistors

Ref.	b	c	e
Q002	5.9	11.7	5.3
Q003	.7	0	0
Q004	4.9	5.7	5.8
Q007	0.6	0	0
Q008	1.6	5.2	1.6
Q015	5.2	0	5.0
Q101	0	2.8	0
Q103	2.8	8.1	2.2
Q305	1.3	0	2.0
Q306	4.6	8.2	4.0
Q307	3.9	8.2	3.3
Q451	0	2.4	0
Q452	0.2	0.1	0
Q501	0.3	99.6	0
Q531	10.6	16.4	10.2
Q541	0	3.8	0
Q551	0.1	137.4	0
Q753	0.5	9.4	0
Q2301	0	18.1	0
Q2302	18.1	0	18.1

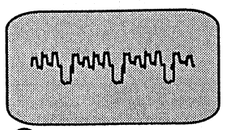
Enable, Data

NOTE: Volta
chan

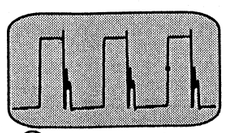
– V
Ch. 02
Ch. 06
Ch. 07
Ch. 13

Waveforms – A–Schematic (27" Models)

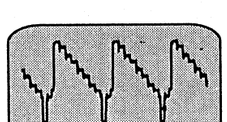
1 0.78V p–p [20µs]



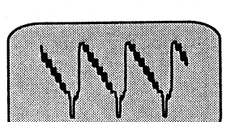
8 3.6V p–p [20µs]



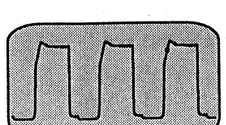
15 2.5V p–p [20µs]



2 0.73V p–p [20µs]

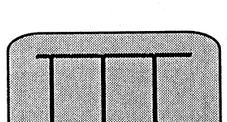


9 1.2V p–p [20µs]

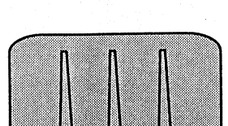


16 200V p–p [20µs]

3 0.45V p–p [20µs]

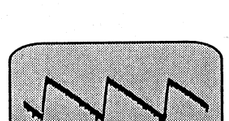


10 4.6V p–p [5ms]

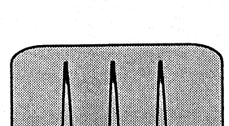


17 254V p–p [20µs]

4 0.2V p–p [20µs]

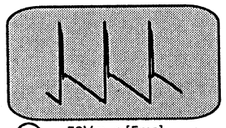


11 3V p–p [5ms]

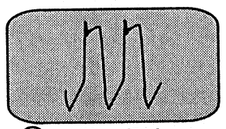


18 29.2V p–p [20µs]

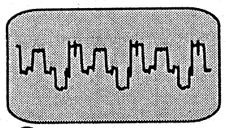
5 0.4V p–p [1µs]



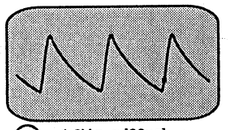
12 56V p–p [5ms]



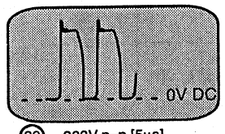
19 14V p–p [5µs]



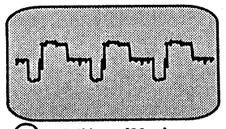
6 4.0V p–p [20µs]



13 1.6V p–p [20µs]



20 292V p–p [5µs]



7 3.4V p–p [20µs]

14 0.8V p–p [5µs]

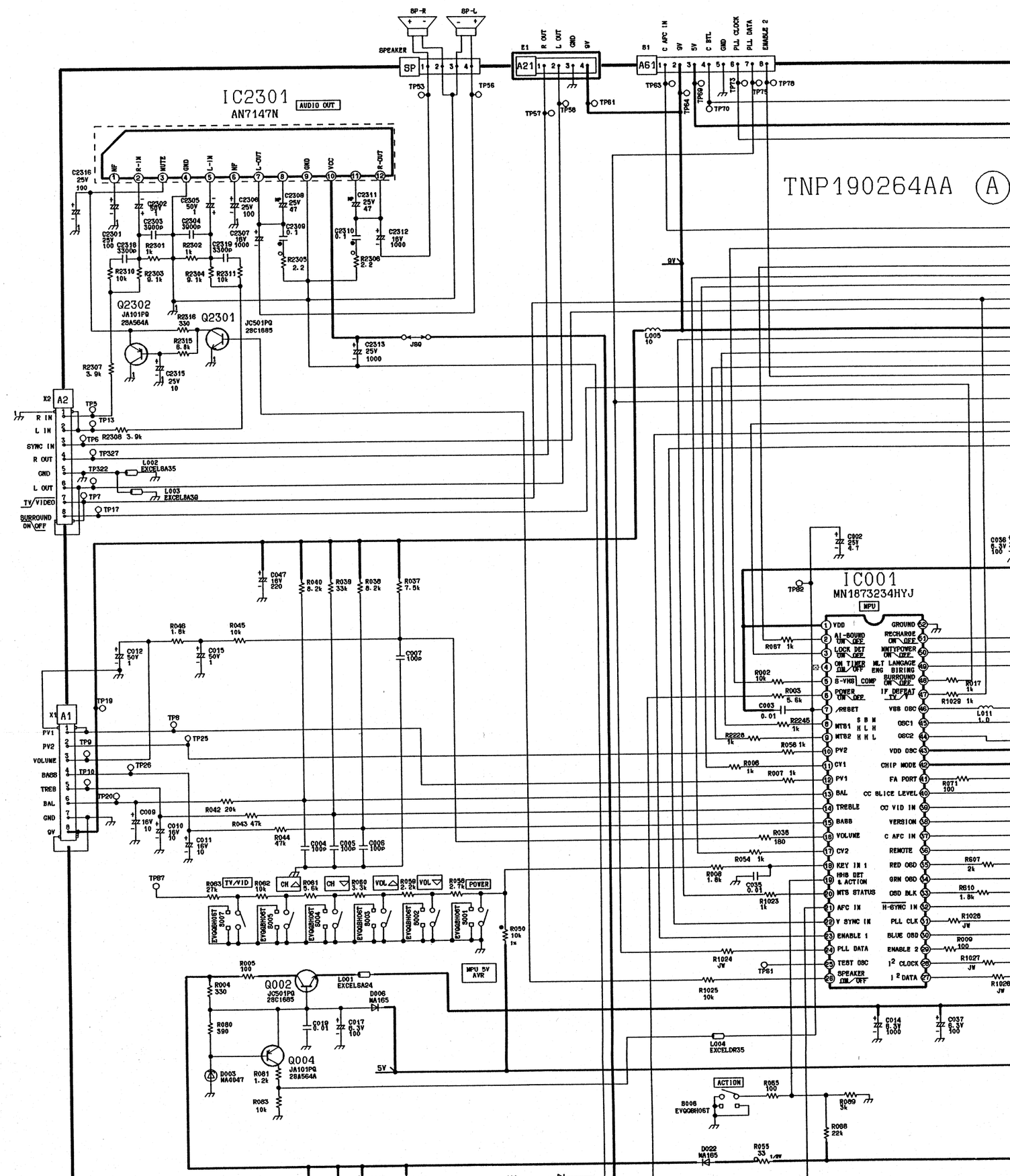
Waveform Measurements

1. (3) indicates waveform measurement. (Measurement can be taken at best accessible location in common to indicated point.)
2. Taken with a NTSC signal generator connected to antenna terminal. (NTSC color bar pattern of 8 bars of EIA colors, 100 IRE white and 7.5 IRE black)
3. Customer Controls (Picture/Audio Menu) are set to Normalize. Volume "MIN".
4. All video and color waveforms taken in Service Mode 1.
5. Ground symbol ⏚ shown on waveform number indicates (Hot) ground lead connection of Oscilloscope.

   CAUTION: Incorrect ground connection of test equipment will result in erroneous readings.

These waveforms have been taken in the order of circuit flow through the various sections as follows:

VIDEO – Waveforms 1~3
COLOR – Waveforms 4~8
VERTICAL – Waveforms 9~12



Waveform Measurements

1. (3) indicates waveform measurement. (Measurement can be taken at best accessible location in common to indicated point.)
2. Taken with a NTSC signal generator connected to antenna terminal. (NTSC color bar pattern of 8 bars of EIA colors, 100 IRE white and 7.5 IRE black)
3. Customer Controls (Picture/Audio Menu) are set to Normalize. Volume "MIN".
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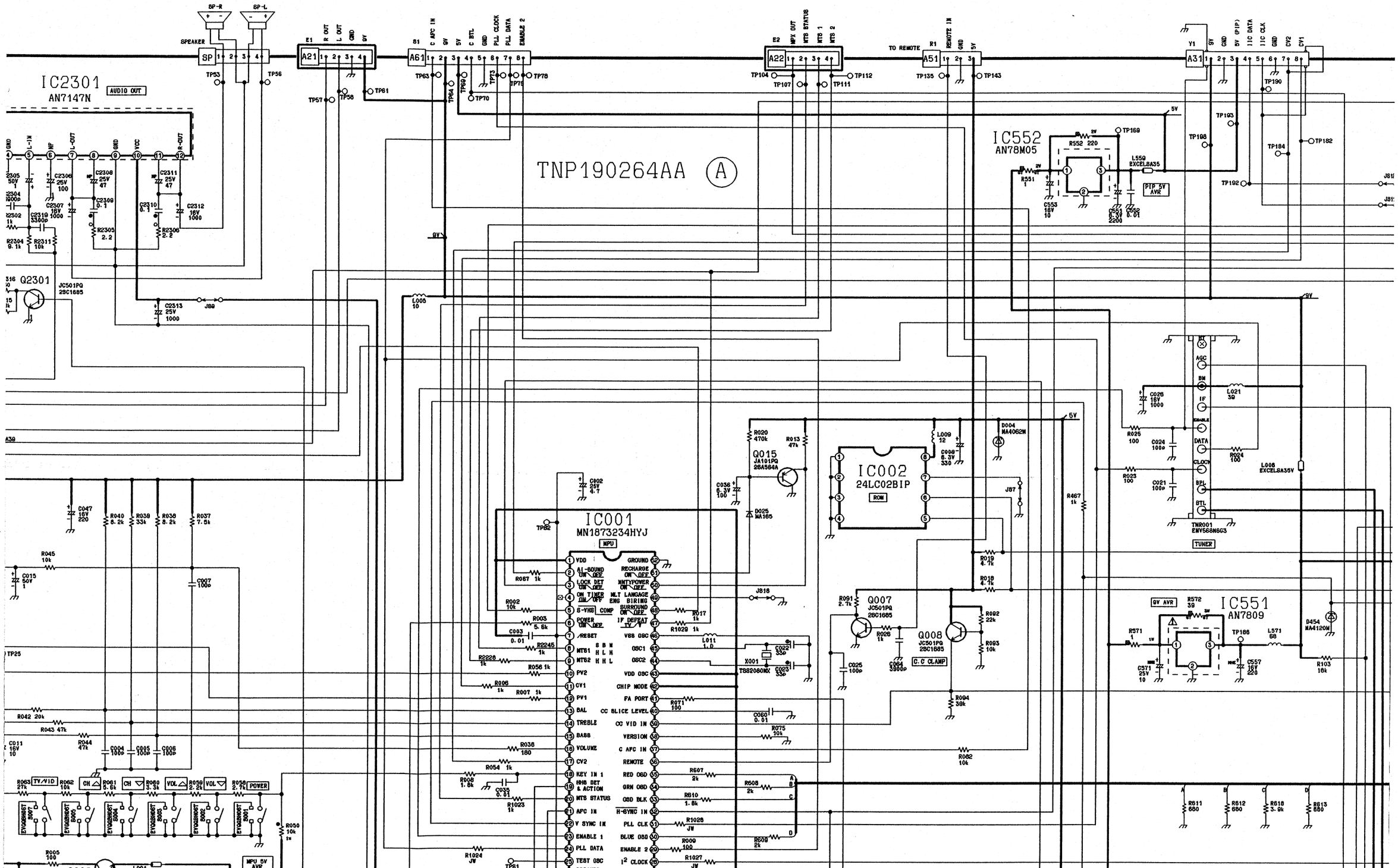
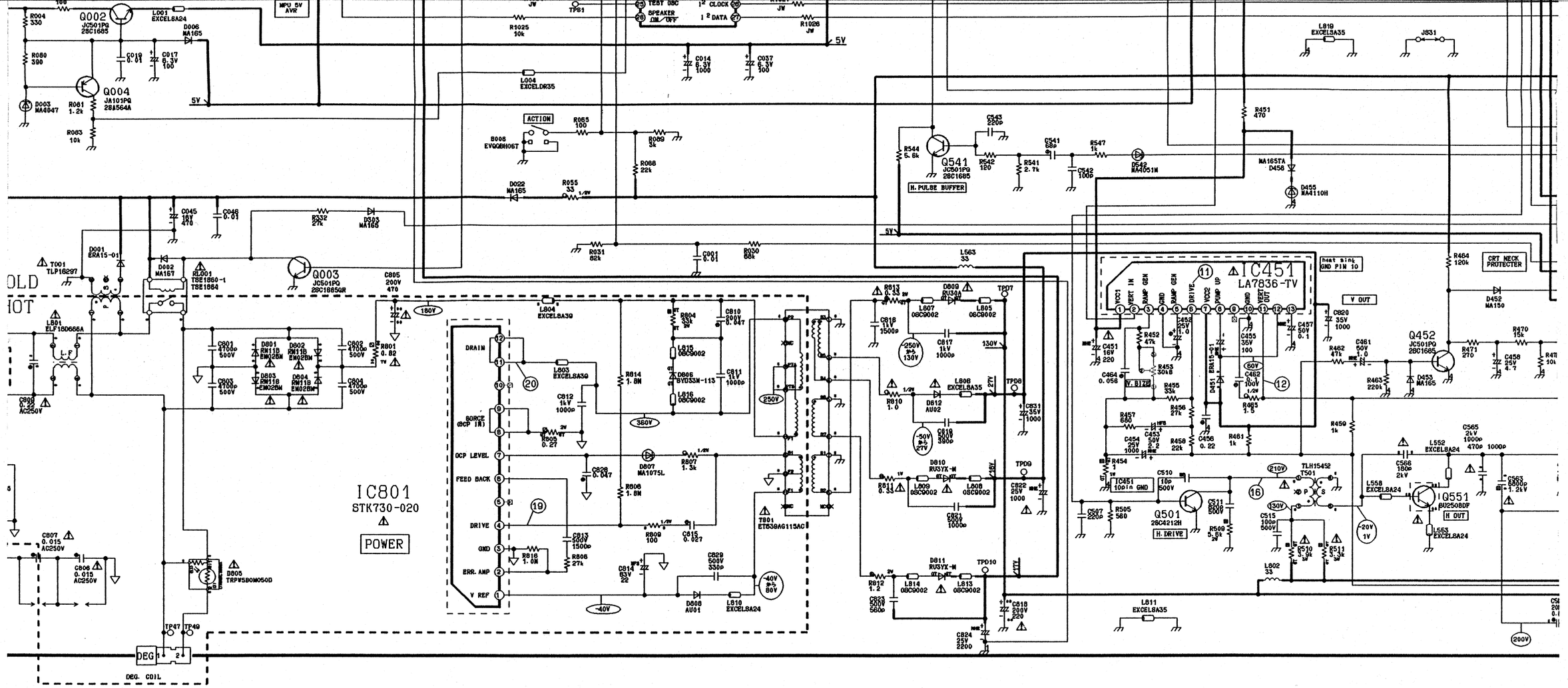
These waveforms have been taken in the order of circuit flow through the various sections as follows:

VIDEO – Waveforms 1~3
COLOR – Waveforms 4~8
VERTICAL – Waveforms 9~12

A–Board Schematic (27” Models)





art – A–Board (27" Models)

Cs)

IC101

1	2.5	23	4.3	45	6.2
2	1.7	24	2.7	46	2.6
3	3.7	25	4.6	47	4.2
4	0	26	4.0	48	2.1
5	0	27	2.4	49	2.7
6	0	28	0	50	0.8
7	0	29	2.7	51	5.8
8	5.2	30	8.2	52	4.1
9	2.5	31	4.6		
10	2.5	32	2.9		
11	2.5	33	2.4		
12	8.2	34	2.8		
13	2.4	35	1.8		
14	5.8	36	3.0		
15	4.9	37	3.0		
16	4.9	38	5.0		
17	5.0	39	3.5		
18	2.9	40	2.6		
19	3.0	41	0		
20	0	42	2.5		
21	0	43	2.0		
22	2.6	44	0.3		

IC451

1	12.5
2	4.1
3	6.2
4	0
5	6.5
6	5.3
7	26.0
8	2.4
9	1.1
10	0
11	15.0
12	26.6
13	5.3

IC551

1	16.4
2	0
3	8.8

IC552

1	12.5
2	0
3	5.0

IC553

1	16.4
2	12.0
3	0

IC801 ⏚

1	– 39.5
2	– 32.8
3	0
4	– 0.1
5	1.7
6	1.5
7	– 0.3
8	0.3
9	0.3
10	NC
11	VARIES 141~154
12	VARIES 141~154

IC2301

1	1.2
2	0
3	18.1
4	0
5	0
6	1.2
7	9.7
8	17.2
9	0
10	18.3
11	17.2
12	9.4

Transistors

Ref.	b	c	e
Q002	5.9	11.7	5.3
Q003	.7	0	0
Q004	4.9	5.7	5.8
Q007	0.6	0	0
Q008	1.6	5.2	1.6
Q015	5.2	0	5.0
Q101	0	2.8	0
Q103	2.8	8.1	2.2
Q305	1.3	0	2.0
Q306	4.6	8.2	4.0
Q307	3.9	8.2	3.3
Q451	0	2.4	0
Q452	0.2	0.1	0
Q501	0.3	99.6	0
Q531	10.6	16.4	10.2
Q541	0	3.8	0
Q551	0.1	137.4	0
Q753	0.5	9.4	0
Q2301	0	18.1	0
Q2302	18.1	0	18.1

Tuner Voltage Chart

Enable, Data, and Clock have no DC readings. They are digital signals from the MPU.

NOTE: Voltage at the 30V test pin varies with channel selection. Refer to chart for sample tuning voltages of TV/CATV(CABLE) channels as shown.

Voltage Reading Are Nominal And May Vary ± 15%

– VHF –	
Ch. 02	4.0V
Ch. 06	8.2V
Ch. 07	7.0V
Ch. 13	9.3V

– UHF –	
Ch. 14	7.7V
Ch. 69	24V

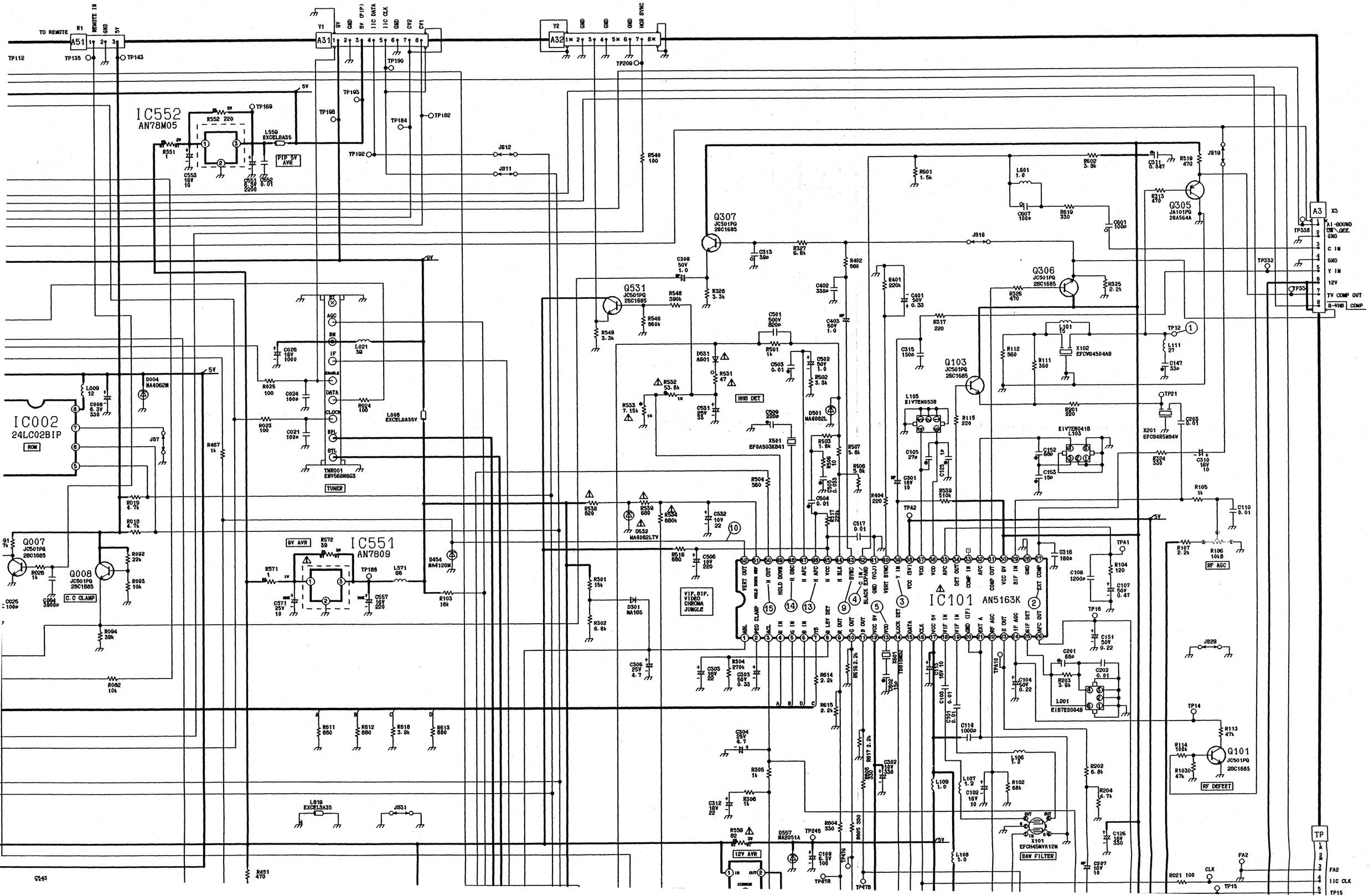
– CABLE –					
1st Band		2nd Band		3rd Band	
Ch. 1	6.7V	Ch. 16	4.5V	Ch. 47	3.7V
Ch. 15	24.7V	Ch. 46	2.70V	Ch. 94	14.9V
Ch. 95	9.8V			Ch. 100	15.1V
Ch. 99	17.5V			Ch. 125	24.0V

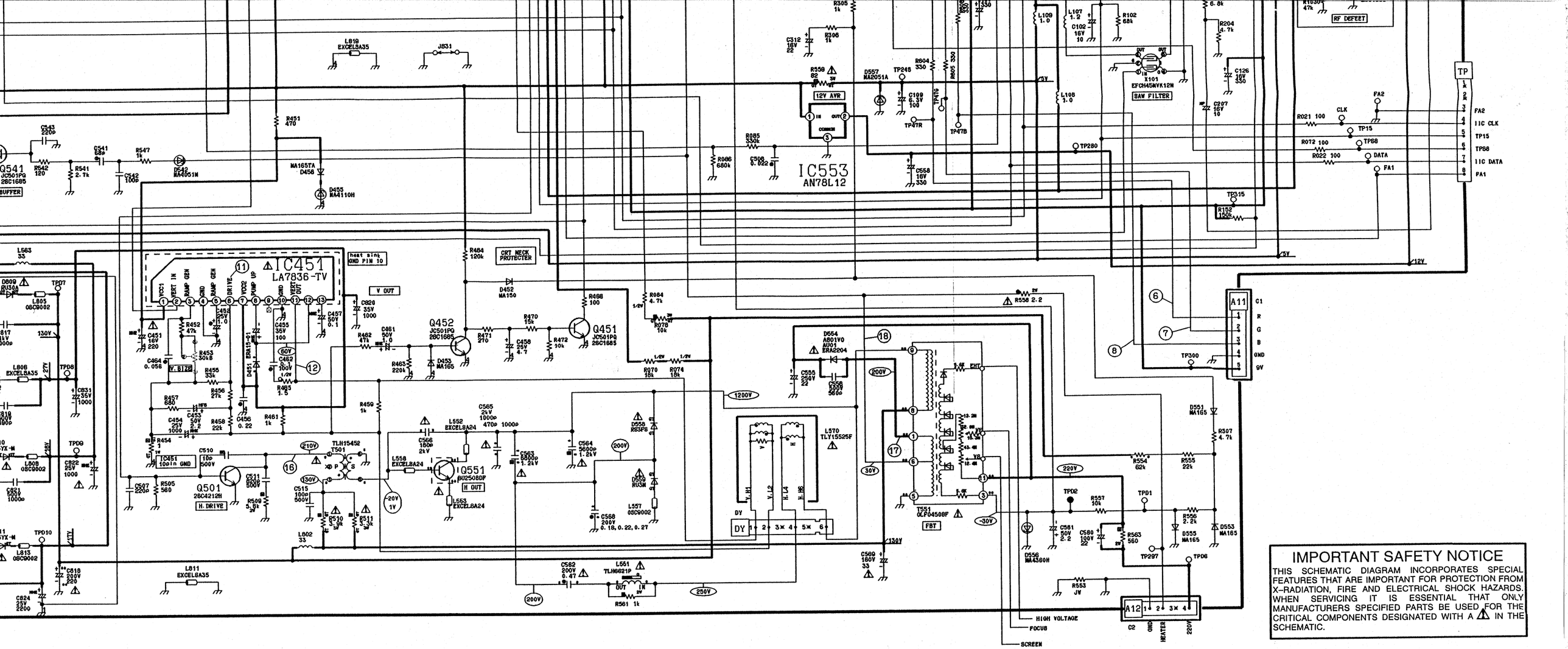
MICROPI

VHF	
UHF	
CAB	

NOTE: C
E
–(

Board Schematic (27” Models)





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Tuner Voltage Chart

DC readings. They are digital signals from the MPU.
n varies with channel selection. Refer to chart for sample tuning voltages of TV/CATV(CABLE)

Voltage Reading Are Nominal And May Vary ± 15%

– UHF –	
Ch. 14	7.7V
Ch. 69	24V

– CABLE –					
1st Band		2nd Band		3rd Band	
Ch. 1	6.7V	Ch. 16	4.5V	Ch. 47	3.7V
Ch. 15	24.7V	Ch. 46	2.70V	Ch. 94	14.9V
Ch. 95	9.8V			Ch. 100	15.1V
Ch. 99	17.5V			Ch. 125	24.0V

MICROPROCESSOR PROGRAMMING FOR BAND TUNING/SWITCHING

54MHz ◄► 130MHz ◄► 360MHz ◄► 806MHz

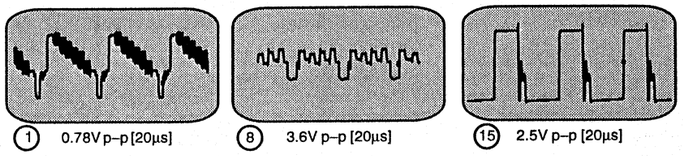
	FIRST TUNING BAND	SECOND TUNING BAND	THIRD TUNING BAND
VHF	02~06	07~13	
UHF			14~69
CABLE	01~06,14,15,95~99	07~13,16~46	47~94,100~125

NOTE: CABLE channel numbers as recommended by the joint EIA/NCTA Engineering Committee and published as EIA INTERIM STANDARD NO. 6 – CABLE TELEVISION CHANNEL IDENTIFICATION PLAN – MAY 1983.

Circuit Board Function Index

CIRCUIT BOARDS	FUNCTION
A–BOARD	Main
C–BOARD	CRT
E–BOARD	Stereo/SAP Decoder
R ASSEMBLY	Remote Receiver
S–BOARD	2nd Tuner (PIP)
X–BOARD	A/V Input Jacks, V1–V2 Input Switch,TV–Video Switch,AI Sound, Surround Sound, Audio Control & Variable Audio Output
Y–BOARD	PIP Processing Assembly
Z–BOARD	Pincushion Correction **(31" Models Only)**

Waveforms – A–Schematic (31" Models)



① 0.78V p–p [20µs]
⑧ 3.6V p–p [20µs]
⑮ 2.5V p–p [20µs]
② 0.73V p–p [20µs]
⑨ 1.2V p–p [20µs]
⑯ 200V p–p [20µs]
③ 0.45V p–p [20µs]
⑩ 4.6V p–p [5ms]
⑰ 254V p–p [20µs]
④ 0.2V p–p [20µs]
⑪ 3V p–p [5ms]
⑱ 29.2V p–p [20µs]
⑤ 0.4V p–p [1µs]
⑫ 56V p–p [5ms]
⑲ 14V p–p [5µs]
⑥ 4.0V p–p [20µs]
⑬ 1.6V p–p [20µs]
⑳ 292V p–p [5µs]
⑦ 3.4V p–p [20µs]
⑭ 0.8V p–p [5µs]

Waveform Measurements

1. ③ indicates waveform measurement. (Measurement can be taken at best accessible location in common to indicated point.)
2. Taken with a NTSC signal generator connected to antenna terminal. (NTSC color bar pattern of 8 bars of EIA colors, 100 IRE white and 7.5 IRE black)
3. Customer Controls (Picture/Audio Menu) are set to Normalize. Volume
5. Ground symbol ⏚ shown on waveform number indicates (Hot) ground lead connection of Oscilloscope.

   CAUTION: Incorrect ground connection of test equipment will result in erroneous readings.

These waveforms have been taken in the order of circuit flow through the various sections as follows:

VIDEO – Waveforms 1~3

EIA colors, 100 IRE white and 7.5 IRE black)

3. Customer Controls (Picture/Audio Menu) are set to Normalize. Volume "MIN".
4. All video and color waveforms taken with a wideband scope and a probe with low capacity (10 to 1). Shape and peak amplitudes may vary depending on type of Oscilloscope used and calibration.

These waveforms have been taken in the order of circuit flow through the various sections as follows:

VIDEO – Waveforms 1~3
COLOR – Waveforms 4~8
VERTICAL – Waveforms 9~12
HORIZONTAL – Waveforms 13~16
CRT DRIVE – Waveforms 17 & 18
POWER SUPPLY – Waveform 19 ~ 21

Schematic Notes

1. Resistors are carbon 1/4W unless noted otherwise.
2. Capacitors are ceramic 50V unless noted otherwise.
3. Coil value noted is inductance in μH.
4. Test point indicated by ●, Test point but no pin ⚲.
5. Components indicated with ⚠ symbol are critical parts and replacement should be made with manufacture specified replacement parts only.
6. **— (BOLD LINES)** Indicates the route of B+ supply.
7. This schematic diagram is the latest at the time of printing and subject to change without notice.
8. Ground symbol ⏚ indicates **HOT GROUND CONNECTION** and ⏦ indicates COLD GROUND CONNECTION.

NOTE: All other component symbols are used for design engineering purposes.

Voltage Measurements

1. Voltage measurement:
   - AC input to Receiver is 120V. NTSC generator connected to antenna of Receiver. (color bar pattern of 100IRE white and 7.5 IRE black.)
   - All Picture and Audio adjustments set for Normalize.

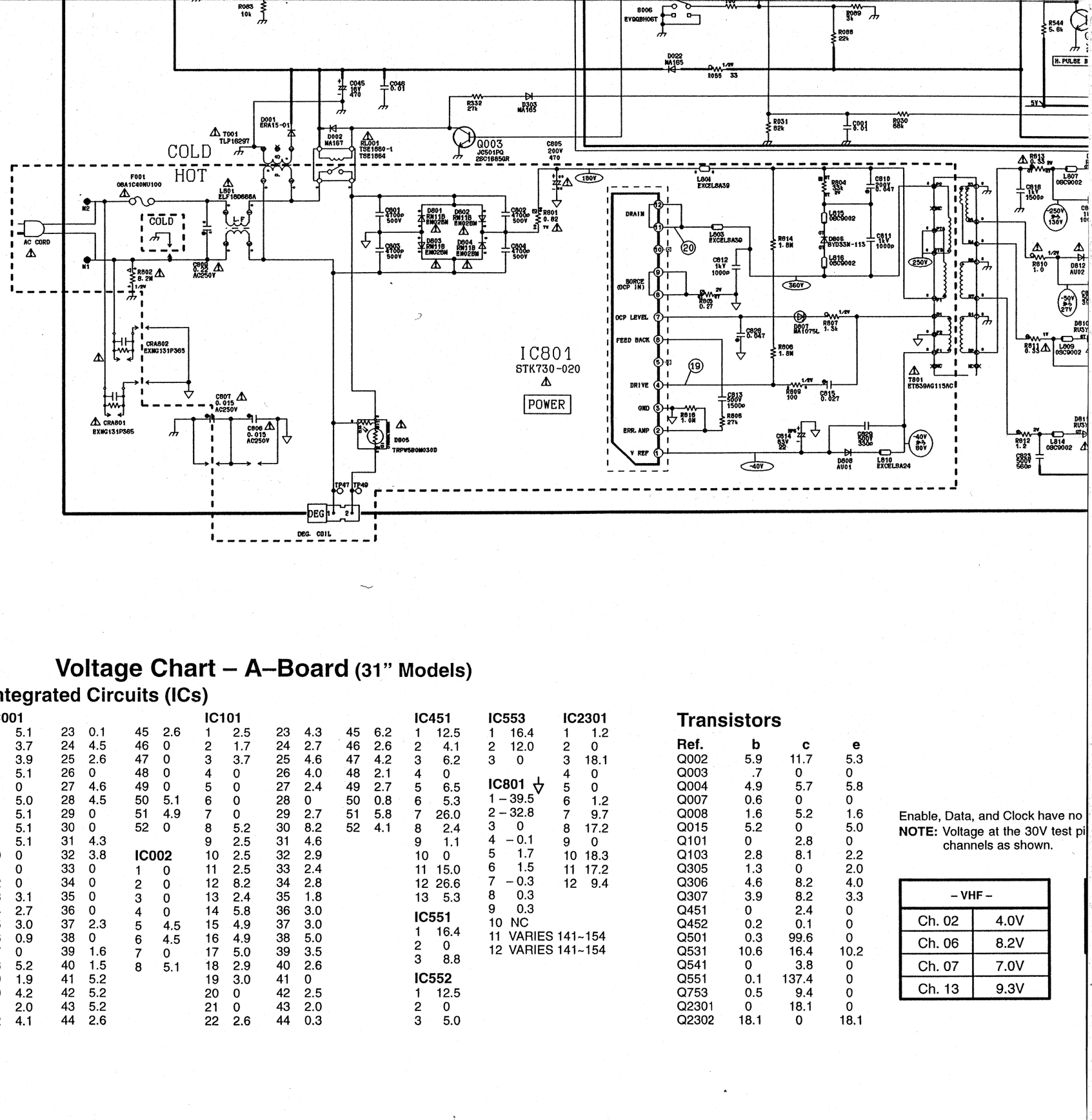
     TV ANT/CABLE – (Set–Up Menu) in TV/ANT Mode

     Volume – Min

     TV/Video SW – TV position

     Audio Mode – Stereo
   - Voltage readings are nominal and may vary ±10% on active devices.

     Some voltage reading will vary with signal strength and picture content.
   - Supply voltages are all nominal.
2. Ground symbol ⏚ indicates ground lead connection of meter. **Caution: Incorrect ground connection will result in erroneous readings.**



Note: Stereo Models

The Functions listed below are activated by a DC voltage change to DAC Inputs (Pin 18 and 19) of MPU IC001. Press and hold a function button on Receiver to take voltage readings.

FUNCTION	PIN 18	PIN 19
POWER	0V~0.6V	0V(Set "OFF")
		0.7V~3.0V (Set "ON")
VOL ◀	0.7V~1.2V	0.7V~3.0V
VOL ▶	1.3V~1.8V	0.7V~3.0V
CH ▼	1.9V~2.4V	0.7V~3.0V
CH ▲	2.6V~3.0V	0.7V~3.0V
TV/VIDEO	3.2V~3.7V	0.7V~3.0V
ACTION	4.6V~5.0V	0V~0.6V

The AUDIO MODES being broadcast are displayed on screen in red by the voltage change to DAC input (Pin 20) of MPU IC001.

AUDIO MODE BROADCAST	PIN 20
MONO	4.0V~5.0V
SAP	2.3V~4.0V
STEREO	1.0V~2.0V
STEREO & SAP	0V~0.9V

Voltage Chart – A–Board (31" Models)

Integrated Circuits (ICs)

IC001

1	5.1	23	0.1	45	2.6
2	3.7	24	4.5	46	0
3	3.9	25	2.6	47	0
4	5.1	26	0	48	0
5	0	27	4.6	49	0
6	5.0	28	4.5	50	5.1
7	5.1	29	0	51	4.9
8	5.1	30	0	52	0
9	5.1	31	4.3		
10	0	32	3.8		
11	0	33	0		
12	0	34	0		
13	3.1	35	0		
14	2.7	36	0		
15	3.0	37	2.3		
16	0.9	38	0		
17	0	39	1.6		
18	5.2	40	1.5		
19	1.9	41	5.2		
20	4.2	42	5.2		
21	2.0	43	5.2		
22	4.1	44	2.6		

IC002

1	0
2	0
3	0
4	0
5	4.5
6	4.5
7	0
8	5.1

IC101

1	2.5	23	4.3	45	6.2
2	1.7	24	2.7	46	2.6
3	3.7	25	4.6	47	4.2
4	0	26	4.0	48	2.1
5	0	27	2.4	49	2.7
6	0	28	0	50	0.8
7	0	29	2.7	51	5.8
8	5.2	30	8.2	52	4.1
9	2.5	31	4.6		
10	2.5	32	2.9		
11	2.5	33	2.4		
12	8.2	34	2.8		
13	2.4	35	1.8		
14	5.8	36	3.0		
15	4.9	37	3.0		
16	4.9	38	5.0		
17	5.0	39	3.5		
18	2.9	40	2.6		
19	3.0	41	0		
20	0	42	2.5		
21	0	43	2.0		
22	2.6	44	0.3		

IC451

1	12.5
2	4.1
3	6.2
4	0
5	6.5
6	5.3
7	26.0
8	2.4
9	1.1
10	0
11	15.0
12	26.6
13	5.3

IC551

1	16.4
2	0
3	8.8

IC552

1	12.5
2	0
3	5.0

IC553

1	16.4
2	12.0
3	0

IC801 ⏚

1	39.5
2	32.8
3	0
4	–0.1
5	1.7
6	1.5
7	–0.3
8	0.3
9	0.3
10	NC
11	VARIES 141~154
12	VARIES 141~154

IC2301

1	1.2
2	0
3	18.1
4	0
5	0
6	1.2
7	9.7
8	17.2
9	0
10	18.3
11	17.2
12	9.4

Transistors

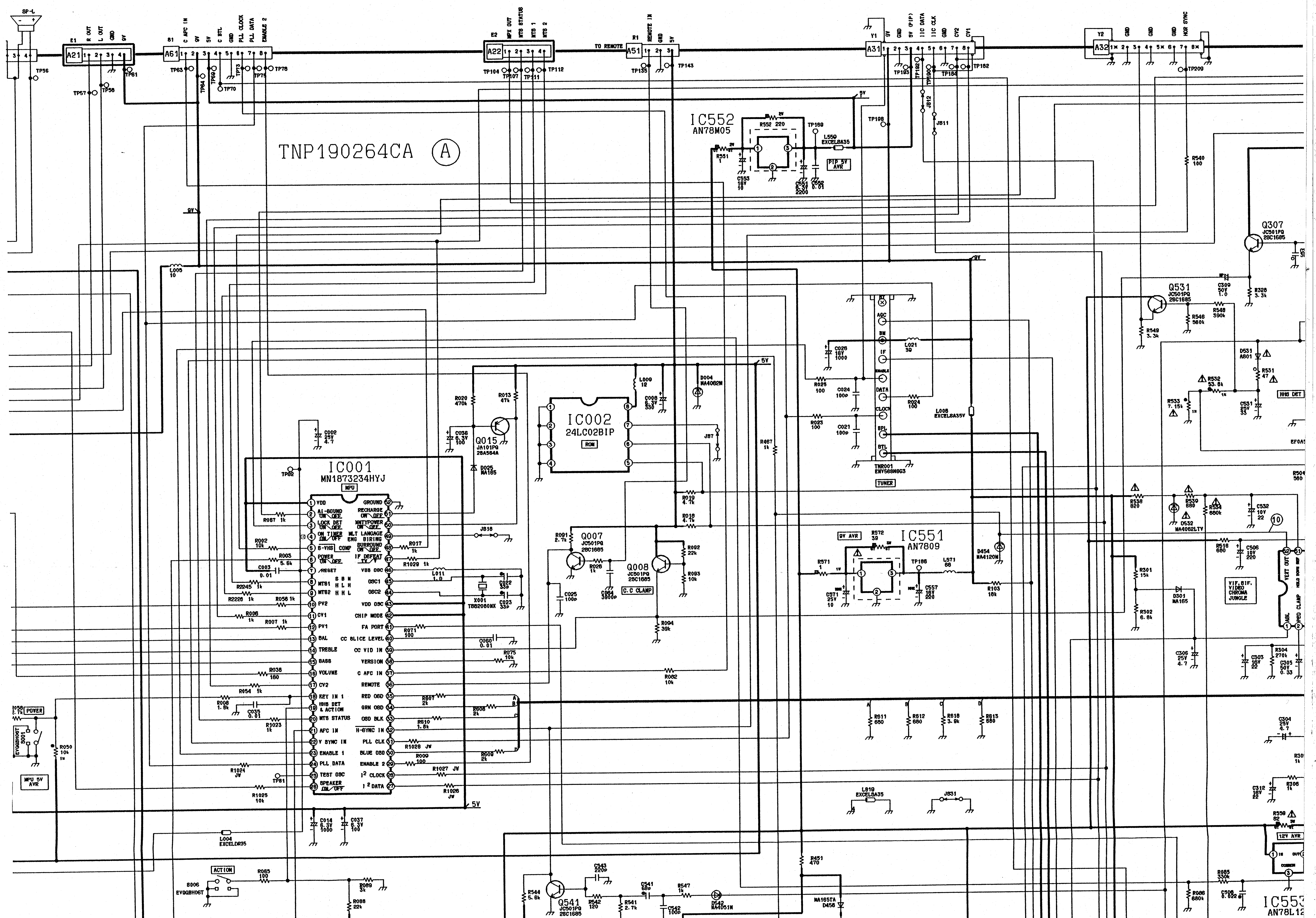
Ref.	b	c	e
Q002	5.9	11.7	5.3
Q003	.7	0	0
Q004	4.9	5.7	5.8
Q007	0.6	0	0
Q008	1.6	5.2	1.6
Q015	5.2	0	5.0
Q101	0	2.8	0
Q103	2.8	8.1	2.2
Q305	1.3	0	2.0
Q306	4.6	8.2	4.0
Q307	3.9	8.2	3.3
Q451	0	2.4	0
Q452	0.2	0.1	0
Q501	0.3	99.6	0
Q531	10.6	16.4	10.2
Q541	0	3.8	0
Q551	0.1	137.4	0
Q753	0.5	9.4	0
Q2301	0	18.1	0
Q2302	18.1	0	18.1

Enable, Data, and Clock have no

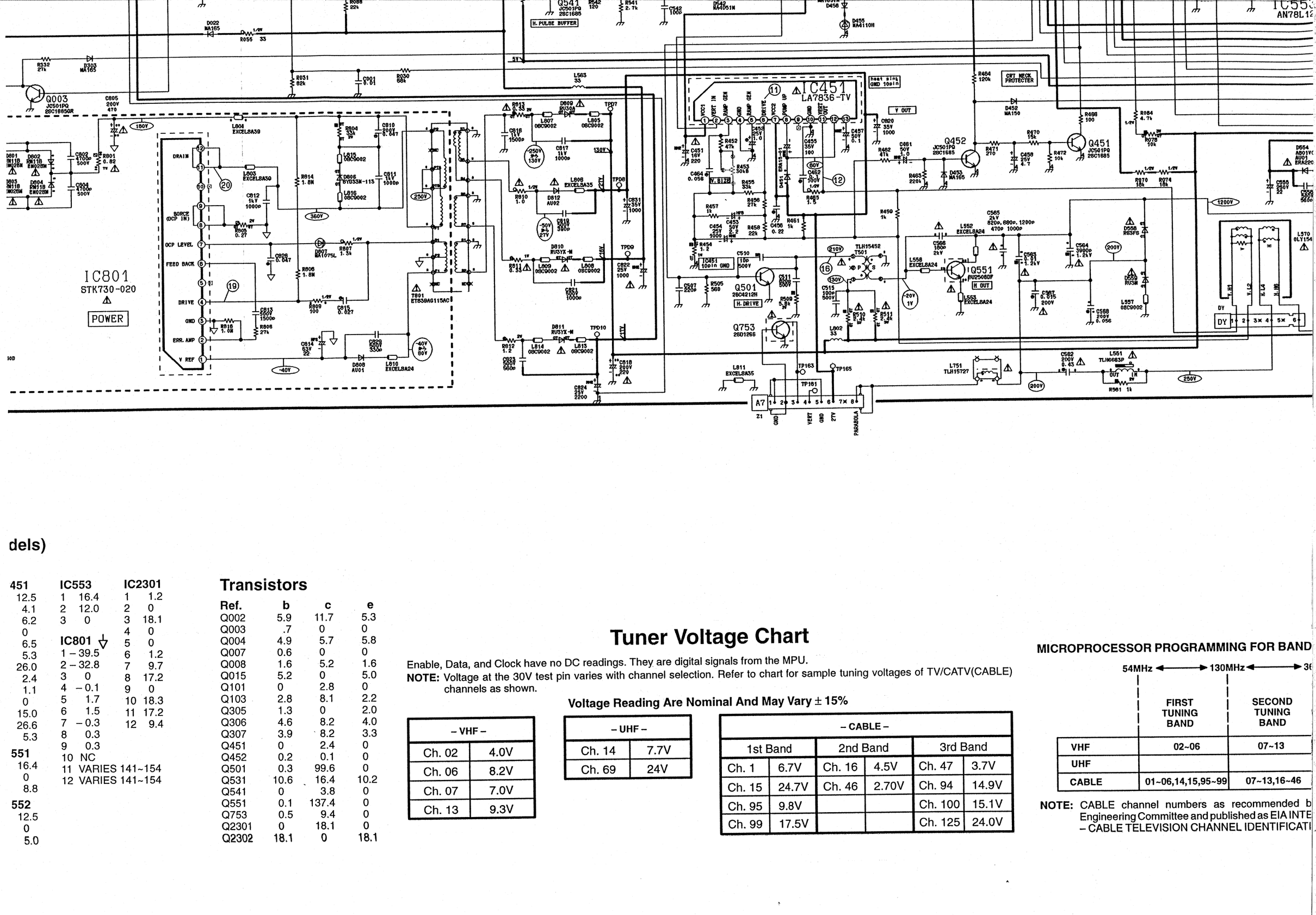
NOTE: Voltage at the 30V test pi channels as shown.

– VHF –	
Ch. 02	4.0V
Ch. 06	8.2V
Ch. 07	7.0V
Ch. 13	9.3V

A–Board Schematic (31" Models)



TNP190264CA
A
IC001
MN1873234HYJ
MPU
IC002
24LC02BIP
ROM
IC552
AN78M05
PIP 5V AVR
IC551
AN7809
9V AVR
Q007
JC501PQ
2SC1685
Q008
JC501PQ
2SC1685
C.C CLAMP
Q015
JA101PQ
2SA564A
Q307
JC501PQ
2SC1685
Q531
JC501PQ
2SC1685
Q541
JC501PQ
2SC1685
TNR001
ENV568N6G3
TUNER
MPU 5V AVR
POWER
ACTION
HHS DET
VIF, SIF, VIDEO CHROMA JUNGLE
12V AVR
IC553
AN78L12
TO REMOTE



dels)

451	IC553	IC2301
12.5	1 16.4	1 1.2
4.1	2 12.0	2 0
6.2	3 0	3 18.1
0		4 0
6.5	IC801	5 0
5.3	1 – 39.5	6 1.2
26.0	2 – 32.8	7 9.7
2.4	3 0	8 17.2
1.1	4 – 0.1	9 0
0	5 1.7	10 18.3
15.0	6 1.5	11 17.2
26.6	7 – 0.3	12 9.4
5.3	8 0.3	
551	9 0.3	
16.4	10 NC	
0	11 VARIES 141~154	
8.8	12 VARIES 141~154	
552		
12.5		
0		
5.0		

Transistors

Ref.	b	c	e
Q002	5.9	11.7	5.3
Q003	.7	0	0
Q004	4.9	5.7	5.8
Q007	0.6	0	0
Q008	1.6	5.2	1.6
Q015	5.2	0	5.0
Q101	0	2.8	0
Q103	2.8	8.1	2.2
Q305	1.3	0	2.0
Q306	4.6	8.2	4.0
Q307	3.9	8.2	3.3
Q451	0	2.4	0
Q452	0.2	0.1	0
Q501	0.3	99.6	0
Q531	10.6	16.4	10.2
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Q551	0.1	137.4	0
Q753	0.5	9.4	0
Q2301	0	18.1	0
Q2302	18.1	0	18.1

Tuner Voltage Chart

Enable, Data, and Clock have no DC readings. They are digital signals from the MPU.

NOTE: Voltage at the 30V test pin varies with channel selection. Refer to chart for sample tuning voltages of TV/CATV(CABLE) channels as shown.

Voltage Reading Are Nominal And May Vary ± 15%

– VHF –	
Ch. 02	4.0V
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Ch. 69	24V

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MICROPROCESSOR PROGRAMMING FOR BAND

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UHF		
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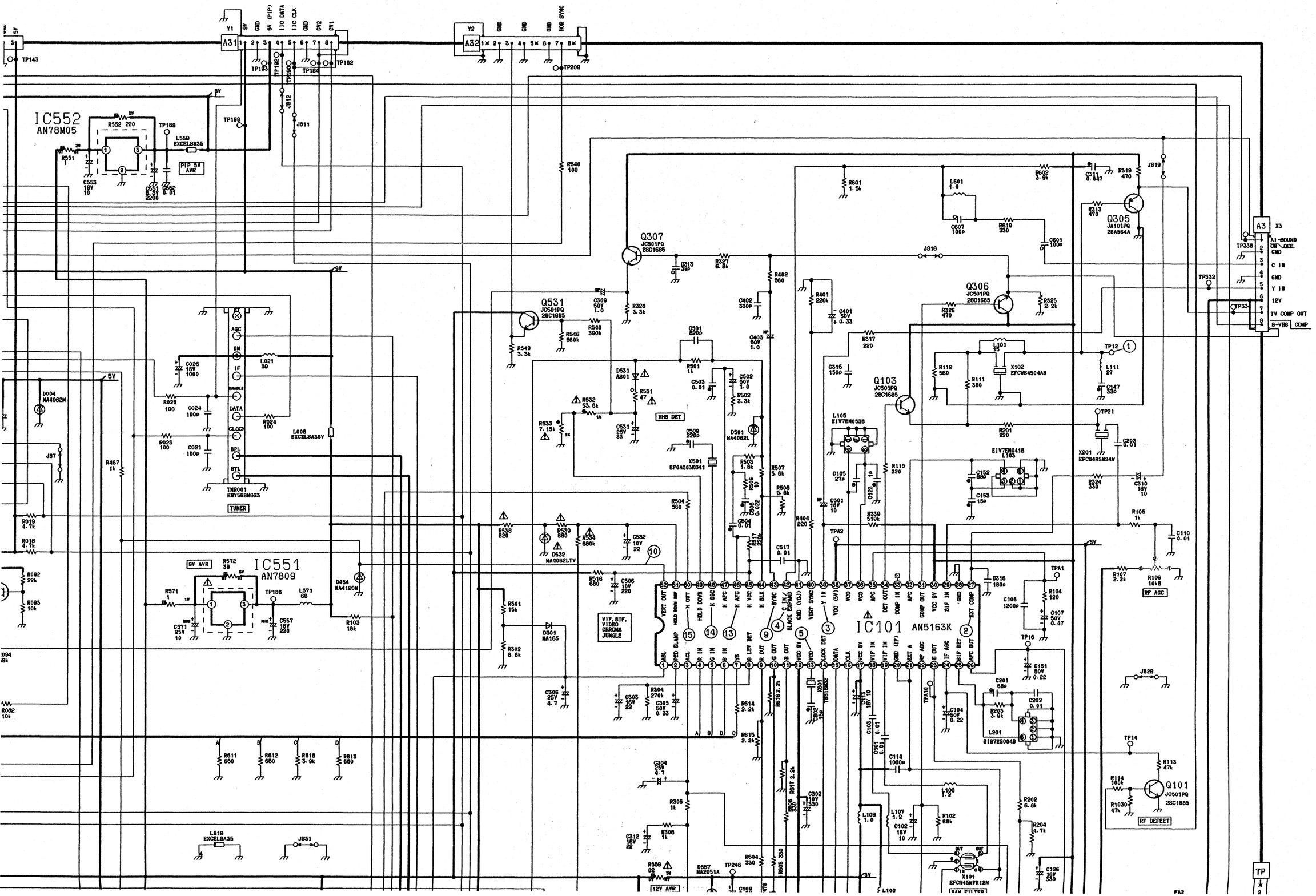
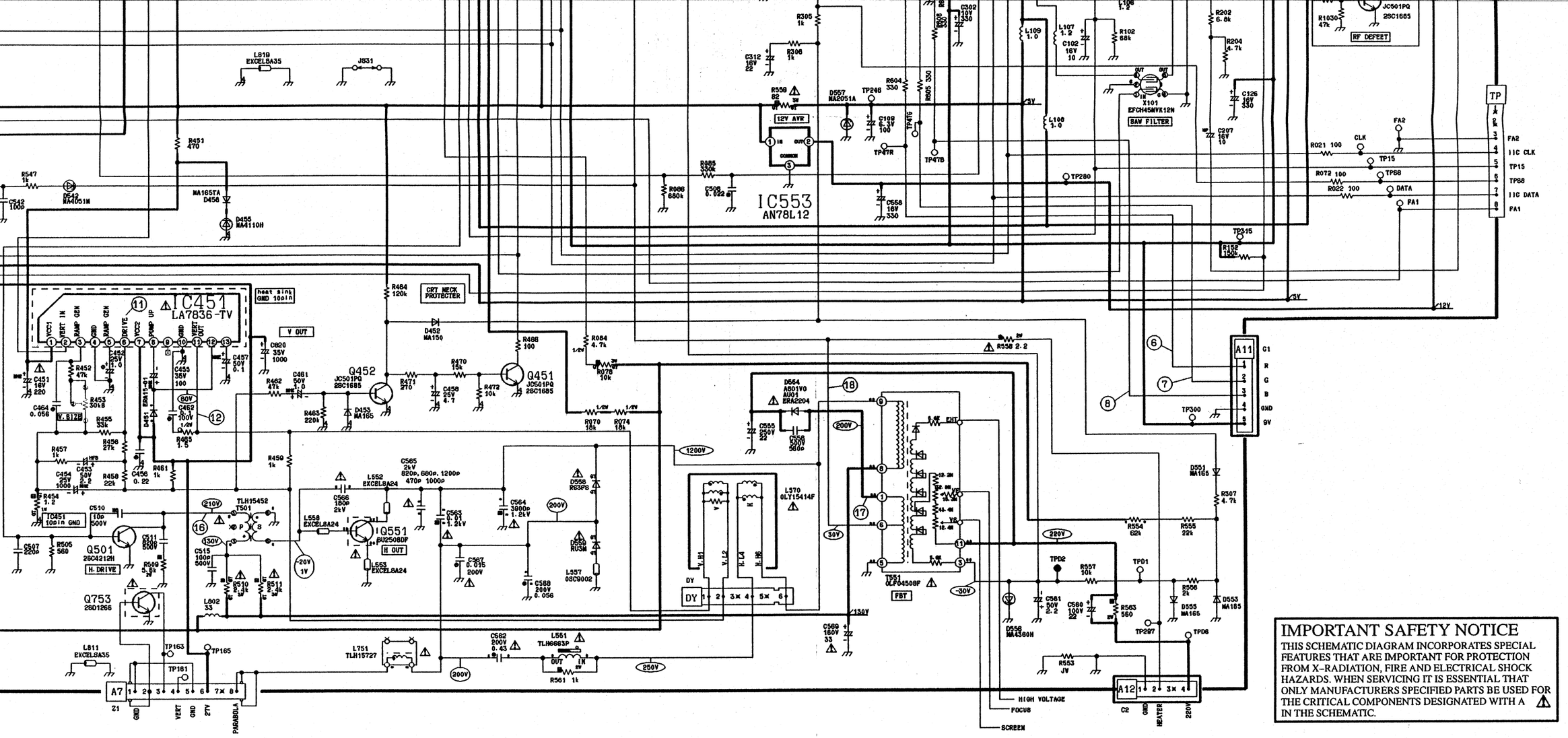
Engineering Committee and published as EIA INTE
– CABLE TELEVISION CHANNEL IDENTIFICATI

chematic (31” Models)





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Voltage Chart

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Y–BOARD	PIP Processing Assembly
Z–BOARD	Pincushion Correction **(31" Models Only)**

Sheet 2 of 5

A–Board Schematic
(31" Models)

Sheet 3 of 5

X & Y–Board Schematics
(All Models)

Y–Board Schematics (All Models)

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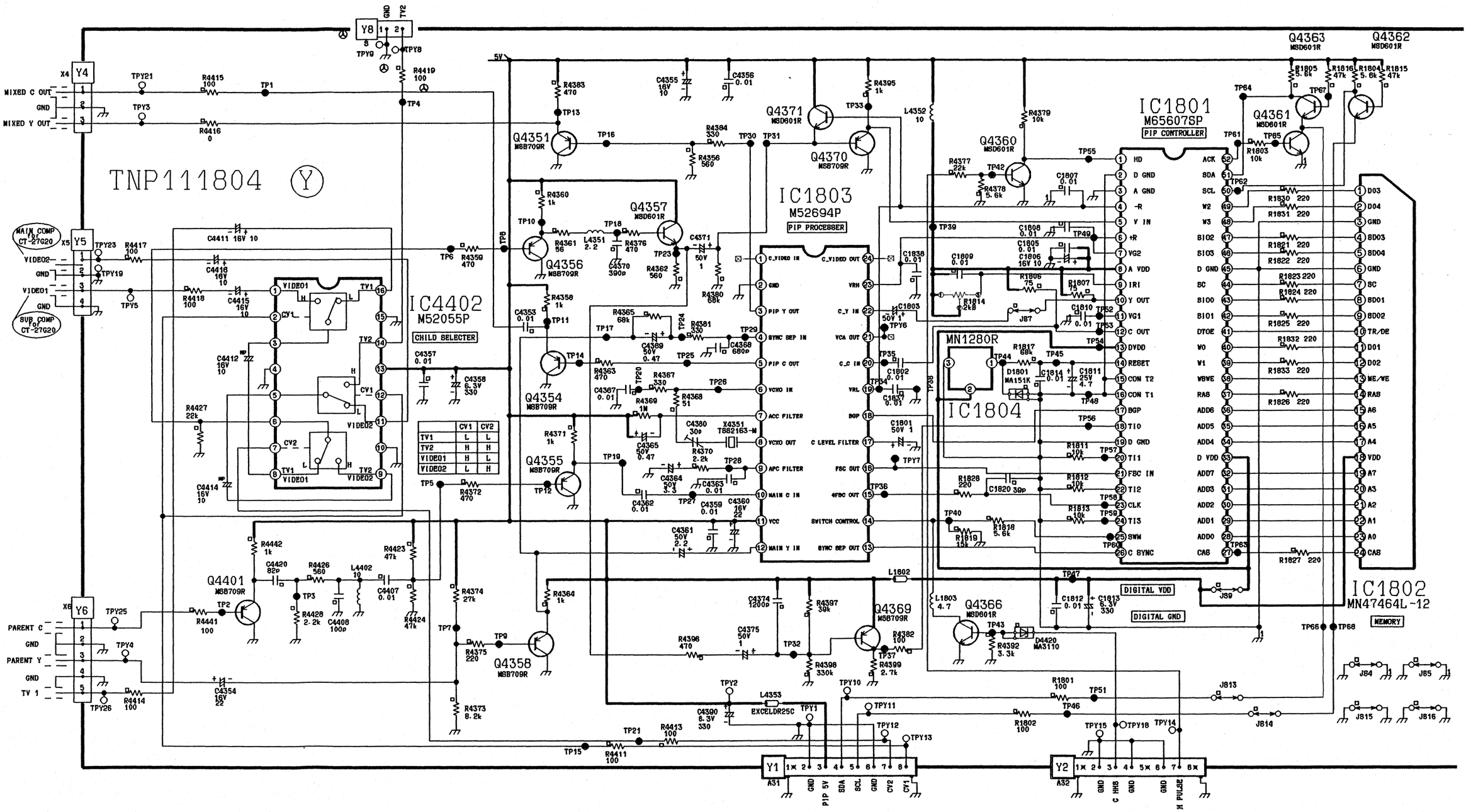


Voltage Chart – Y–Board (All Models)

Integrated Circuits (ICs)

IC1801

1	0.2	27	4.8
2	0	28	0
3	0	29	2.6
4	2.6	30	2.6
5	3.0	31	2.6
6	3.7	32	0
7	3.7	33	4.8
8	5.0	34	2.6
9	3.7	35	2.6
10	4.6	36	0
11	2.1	37	4.8
12	4.6	38	4.8
13	4.8	39	4.2
14	4.8	40	0.2
15	0	41	4.8
16	0	42	0
17	0.2	43	0
18	0.4	44	0
19	0	45	0
20	4.8	46	0
21	1.8	47	0
22	0	48	1.8
23	1.7	49	4.8
24	0	50	4.4
25	0	51	4.6
26	1.0	52	0

IC1804

1	4.8
2	4.8
3	0

IC1802

1	4.8	13	4.8
2	1.8	14	4.8
3	0	15	0
4	0	16	2.6
5	0	17	2.6
6	0	18	4.8
7	0	19	0
8	0	20	2.6
9	0	21	2.6
10	4.8	22	2.6
11	0.2	23	0
12	4.2	24	4.8

IC1803

1	2.6	13	1.0
2	0	14	0
3	1.7	15	1.6
4	3.1	16	1.8
5	1.3	17	2.2
6	3.4	18	0.2
7	4.2	19	2.6
8	2.8	20	2.6
9	2.4	21	3.0
10	2.8	22	3.4
11	5.0	23	3.7
12	3.3	24	2.6

IC4402

1	2.8	9	2.8
2	0	10	0
3	1.6	11	2.8
4	0	12	0
5	1.6	13	5.0
6	1.6	14	2.8
7	0	15	0
8	2.8	16	2.8

Transistors

Ref.	b	c	e
Q4351	1.2	0	1.8
Q4354	1.3	0	2.0
Q4355	2.6	0	3.3
Q4356	1.6	0	2.2
Q4357	2.2	5.0	1.6
Q4358	1.2	0	1.8
Q4360	0.6	0.2	0
Q4361	0	4.6	0
Q4362	4.4	4.4	4.6
Q4363	4.6	4.6	4.6
Q4366	0	0	0
Q4369	4.6	0	5.0
Q4370	2.3	0	3.0
Q4371	2.6	5.0	2.3
Q4401	2.8	0	3.6

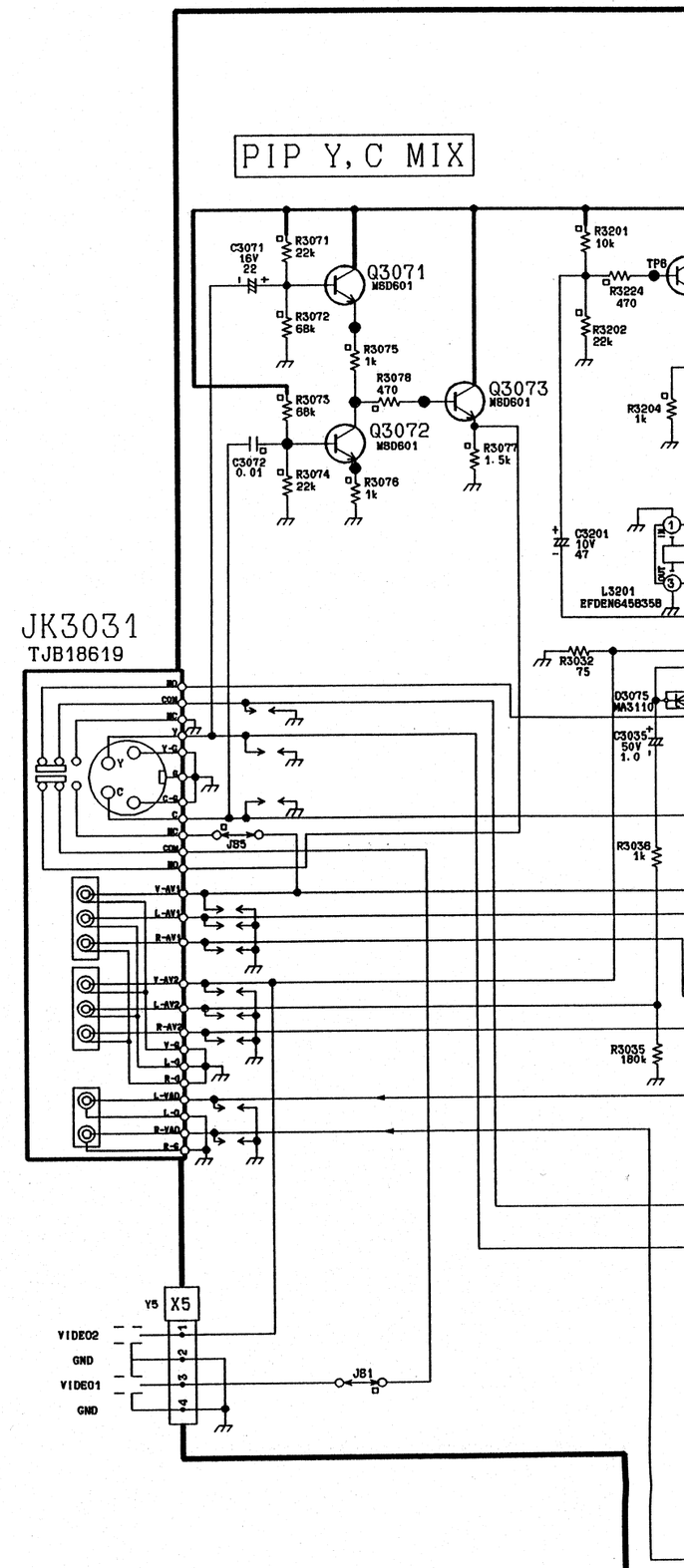
Connectors

Y1

1	8.7
2	0
3	4.9
4	4.6
5	4.5
6	0
7	0
8	0

Y2

1	0
2	0
3	9.5
4	0
5	0
6	0
7	3.8
8	0



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X & Y–Board Schematic (All Models)

X–Board Schematics (All Models)

PIP Y,C MIX

X BOARD TNP111803BZ

JK3031
TJB18619

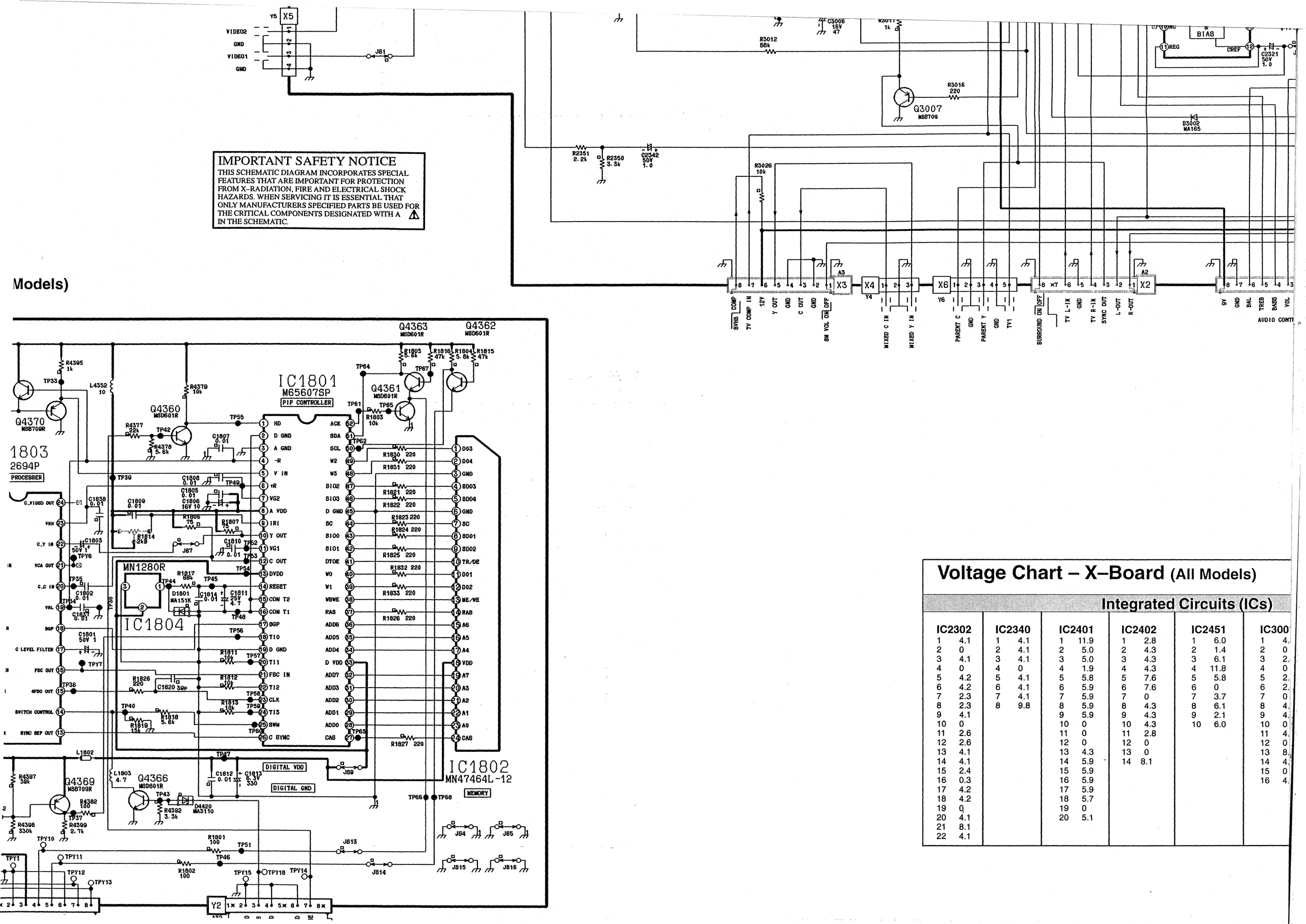
IC3031
M52055P
V1/V2 SW

IC3001
M52055P

TV/VIDEO SWITCH
IC2402
MC14066BCP
MN4066B
M4066BP
UPD4066BC

Q3071 MSD601
Q3072 MSD601
Q3073 MSD601
Q3201 MSD601 COMP-EF
Q3202 MSD601 SUBTRACTER
Q3203 MSD601 ADDER
Q3204 MSD601 C-EF
Q3205 MSD601 Y-EF
Q3206 MSD601 BPF SW
Q3007 MSB709
Q2401 MSD601
Q2402 MSD601

CONTROL & BIAS
TONE
VCA

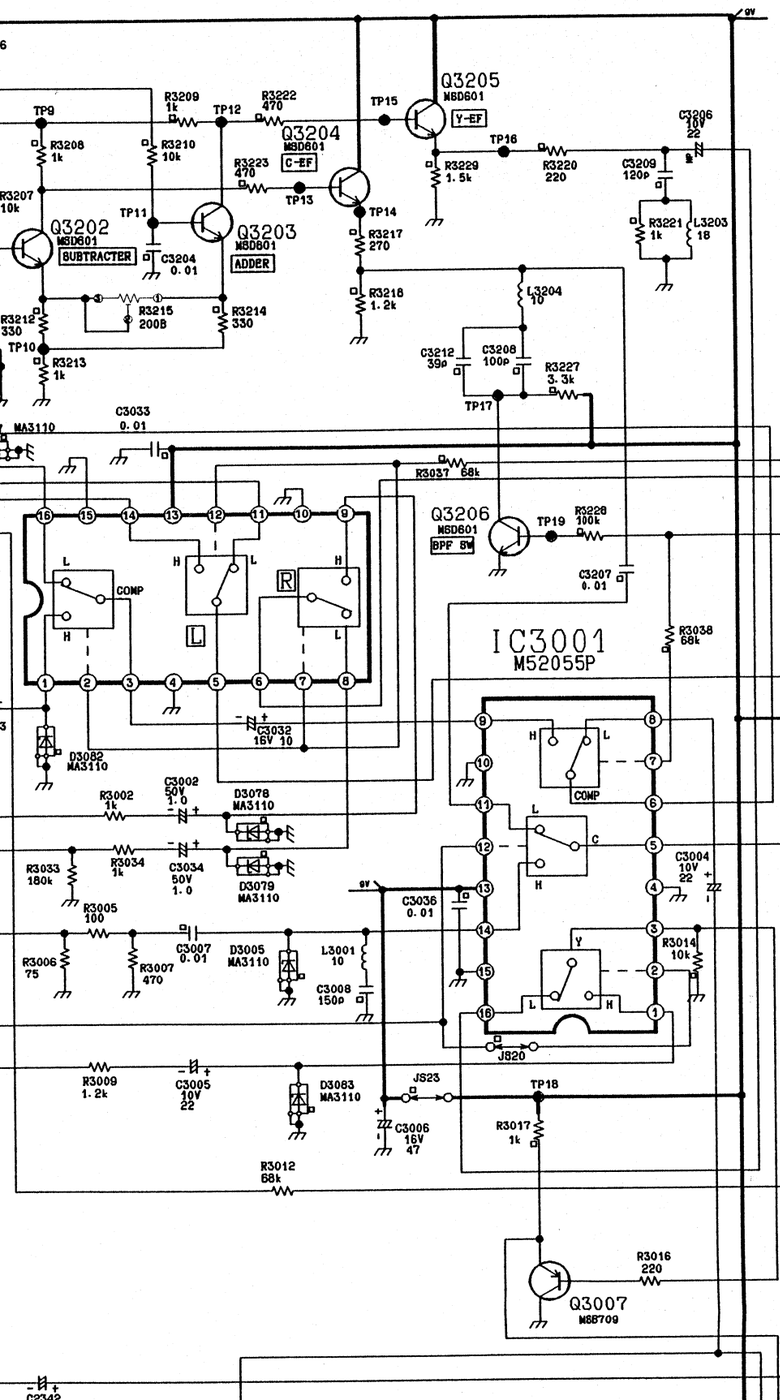


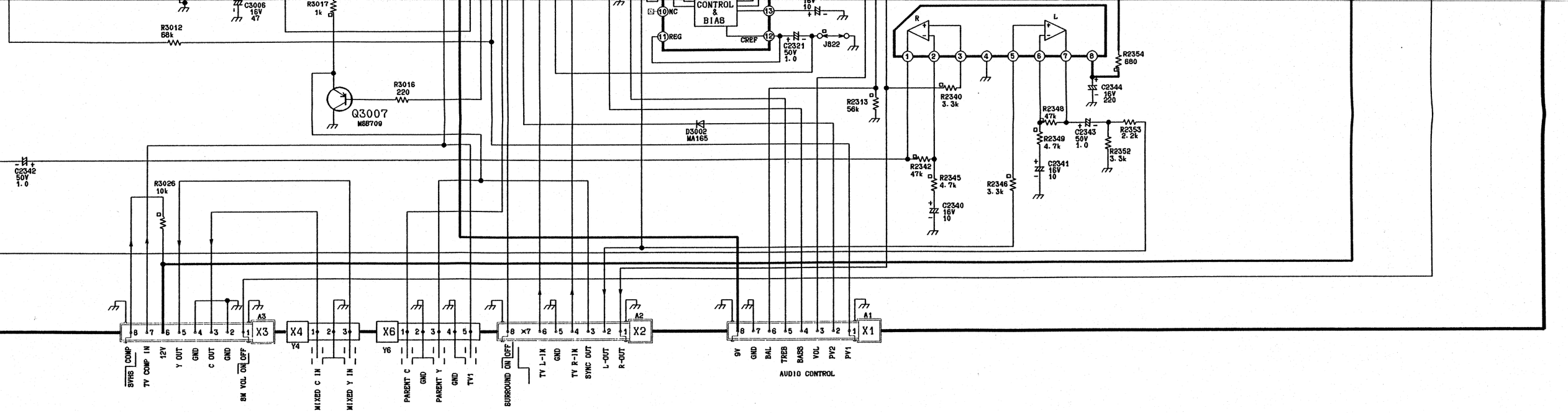
Voltage Chart – X–Board (All Models)

Integrated Circuits (ICs)

IC2302		IC2340		IC2401		IC2402		IC2451		IC300	
1	4.1	1	4.1	1	11.9	1	2.8	1	6.0	1	4.
2	0	2	4.1	2	5.0	2	4.3	2	1.4	2	0
3	4.1	3	4.1	3	5.0	3	4.3	3	6.1	3	2.
4	0	4	0	4	1.9	4	4.3	4	11.8	4	0
5	4.2	5	4.1	5	5.8	5	7.6	5	5.8	5	2.
6	4.2	6	4.1	6	5.9	6	7.6	6	0	6	2.
7	2.3	7	4.1	7	5.9	7	0	7	3.7	7	0
8	2.3	8	9.8	8	5.9	8	4.3	8	6.1	8	4.
9	4.1			9	5.9	9	4.3	9	2.1	9	4.
10	0			10	0	10	4.3	10	6.0	10	0
11	2.6			11	0	11	2.8			11	4.
12	2.6			12	0	12	0			12	0
13	4.1			13	4.3	13	0			13	8.
14	4.1			14	5.9	14	8.1			14	4.
15	2.4			15	5.9					15	0
16	0.3			16	5.9					16	4.
17	4.2			17	5.9						
18	4.2			18	5.7						
19	0			19	0						
20	4.1			20	5.1						
21	8.1										
22	4.1										

(X) BOARD TNP111803BZ





Voltage Chart – X–Board (All Models)

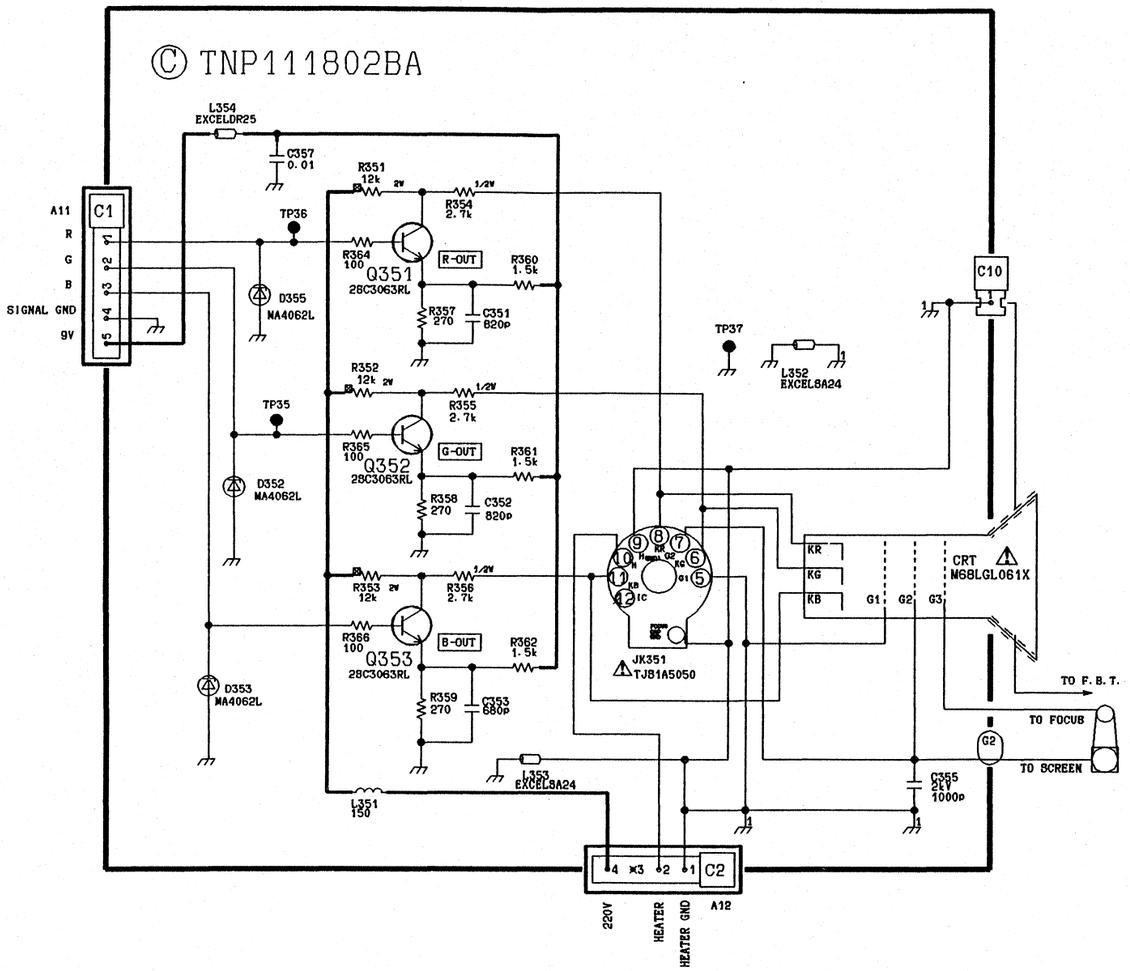
Integrated Circuits (ICs)

IC2302		IC2340		IC2401		IC2402		IC2451		IC3001		IC3031	
1	4.1	1	4.1	1	11.9	1	2.8	1	6.0	1	4.3	1	4.3
2	0	2	4.1	2	5.0	2	4.3	2	1.4	2	0	2	0
3	4.1	3	4.1	3	5.0	3	4.3	3	6.1	3	2.8	3	2.9
4	0	4	0	4	1.9	4	4.3	4	11.8	4	0	4	0
5	4.2	5	4.1	5	5.8	5	7.6	5	5.8	5	2.8	5	2.8
6	4.2	6	4.1	6	5.9	6	7.6	6	0	6	2.8	6	2.8
7	2.3	7	4.1	7	5.9	7	0	7	3.7	7	0	7	0
8	2.3	8	9.8	8	5.9	8	4.3	8	6.1	8	4.3	8	4.3
9	4.1			9	5.9	9	4.3	9	2.1	9	4.3	9	4.3
10	0			10	0	10	4.3	10	6.0	10	0	10	0
11	2.6			11	0	11	2.8			11	4.3	11	4.3
12	2.6			12	0	12	0			12	0	12	0
13	4.1			13	4.3	13	0			13	8.1	13	8.1
14	4.1			14	5.9	14	8.1			14	4.3	14	4.3
15	2.4			15	5.9					15	0	15	0
16	0.3			16	5.9					16	4.3	16	4.3
17	4.2			17	5.9								
18	4.2			18	5.7								
19	0			19	0								
20	4.1			20	5.1								
21	8.1												
22	4.1												

Transistors

Ref.	b	c	e
Q2401	0	7.6	0
Q2402	0.8	0	0
Q3007	2.7	0	3.6
Q3071	6.0	8.1	5.4
Q3072	1.8	4.1	1.3
Q3073	4.1	8.1	3.6
Q3201	5.4	8.1	4.8
Q3202	2.3	4.0	1.6
Q3203	2.3	4.1	1.6
Q3204	4.0	8.1	3.4
Q3205	4.1	8.1	3.4
Q3206	0	8.1	0

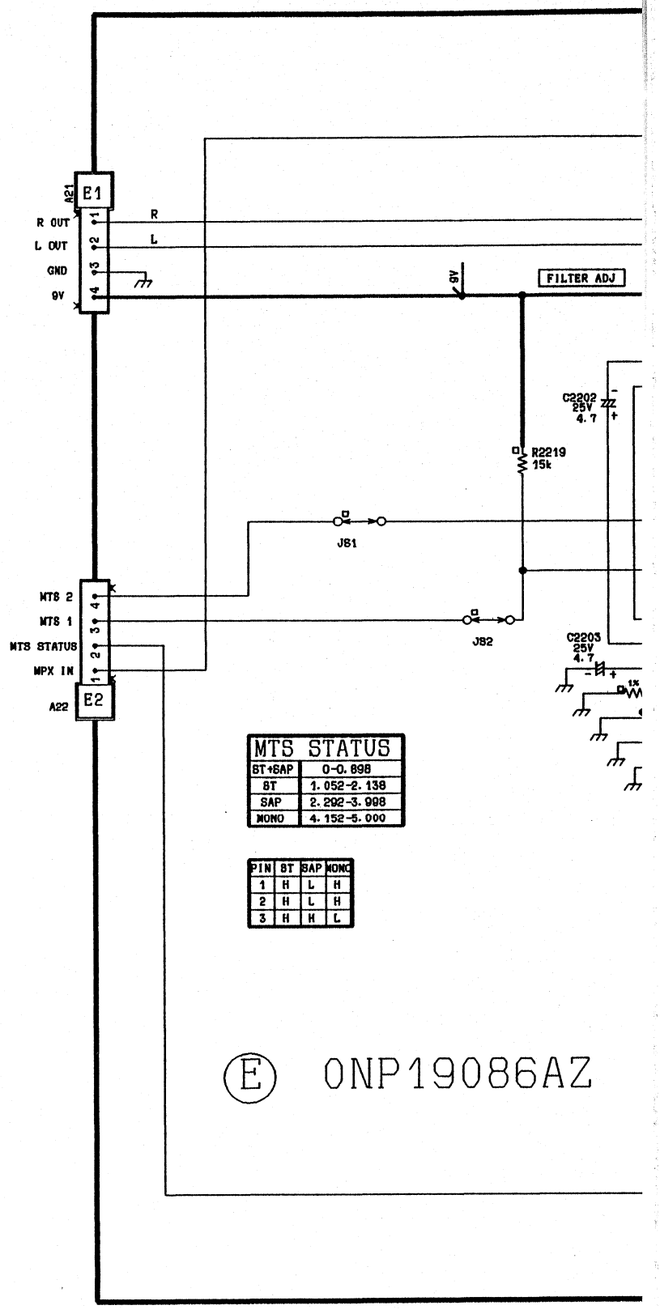
C–Board Schematics (27” Models)



Voltage Chart – CRT–Board
(All Models)

Transistors			
Ref.	**b**	**c**	**e**
Q351	2.8	150.8	2.3
Q352	2.7	155.2	2.2
Q353	2.8	153.8	2.2

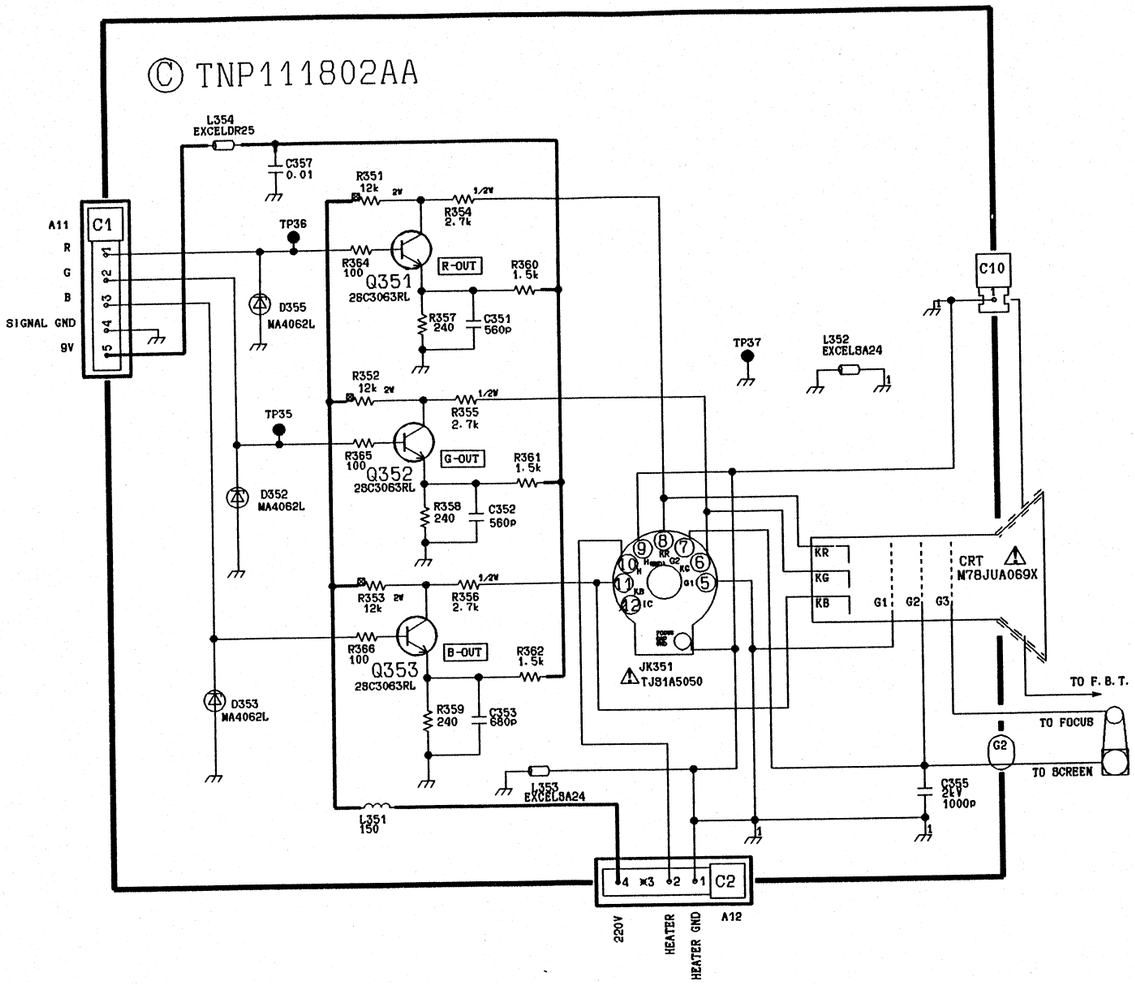
E–Board Sc



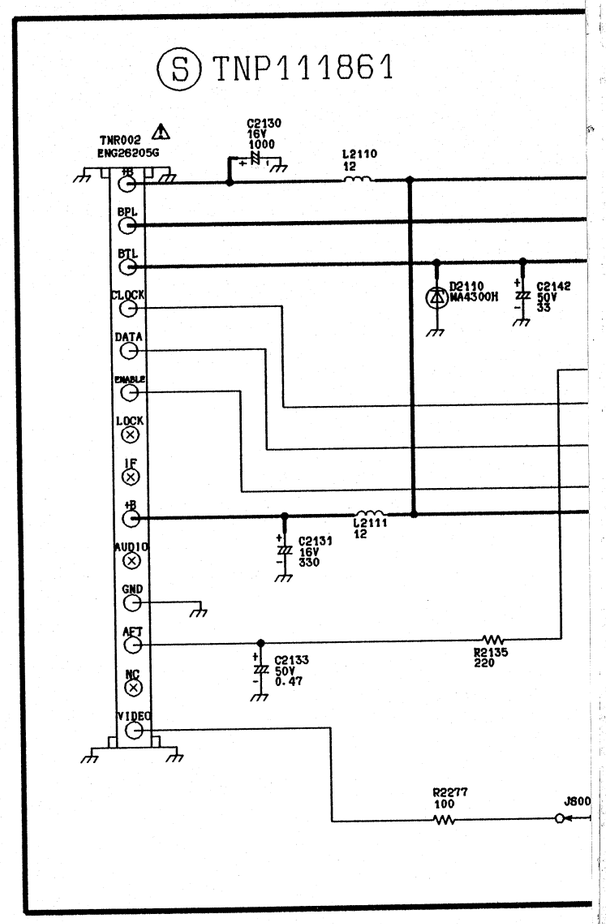
(All Models)

Transistors			
Ref.	**b**	**c**	**e**
Q351	2.8	150.8	2.3
Q352	2.7	155.2	2.2
Q353	2.8	153.8	2.2

C–Board Schematics (31" Models)

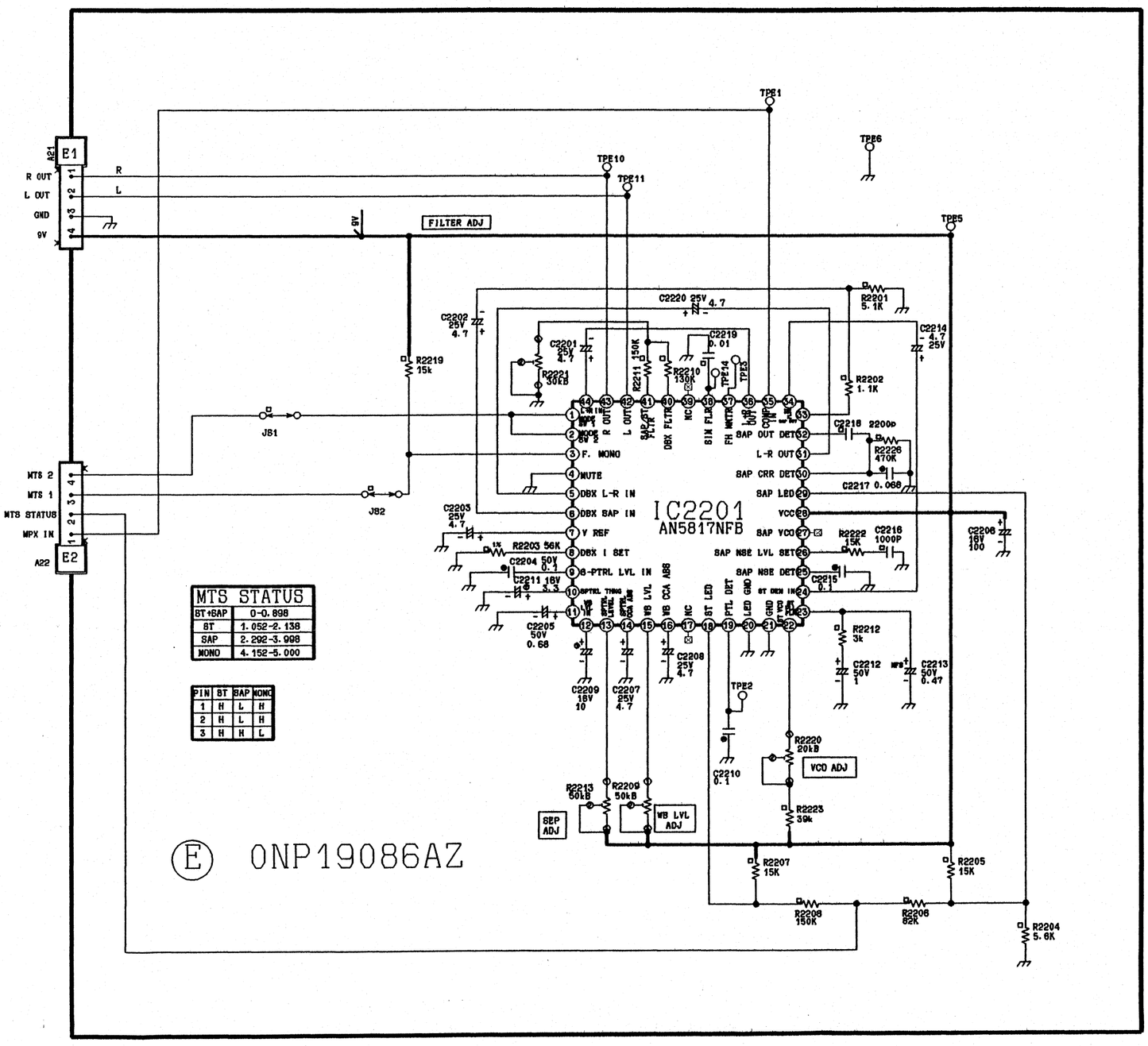


S–Board Schematics (A



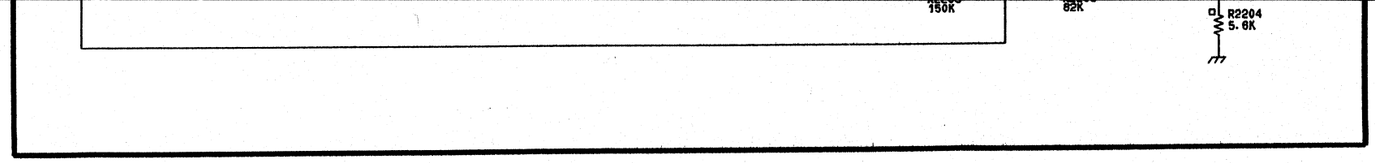
C, E, R, S, & Z–Board Schematics (All Models)

E–Board Schematics (All Models)



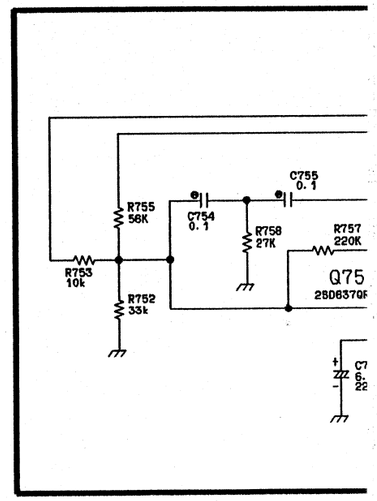
Voltage Chart – E–Boa
(All Models)

Integrated Circuits (ICs)					
IC2201					
1	2.5	12	0.4	23	2.3
2	2.5	13	2.6	24	2.2
3	0	14	1.8	25	3.1
4	0	15	1.4	26	3.2
5	2.1	16	2.7	27	0.1
6	2.2	17	0	28	4.1
7	2.3	18	4.2	29	1.1
8	1.4	19	2.3	30	2.3
9	2.2	20	0	31	2.0
10	1.1	21	0	32	0.3
11	2.5	22	3.4	33	2.9



4	0	15	1.4	26	3.2
5	2.1	16	2.7	27	0.1
6	2.2	17	0	28	4.1
7	2.3	18	4.2	29	1.1
8	1.4	19	2.3	30	2.3
9	2.2	20	0	31	2.0
10	1.1	21	0	32	0.3
11	2.5	22	3.4	33	2.9

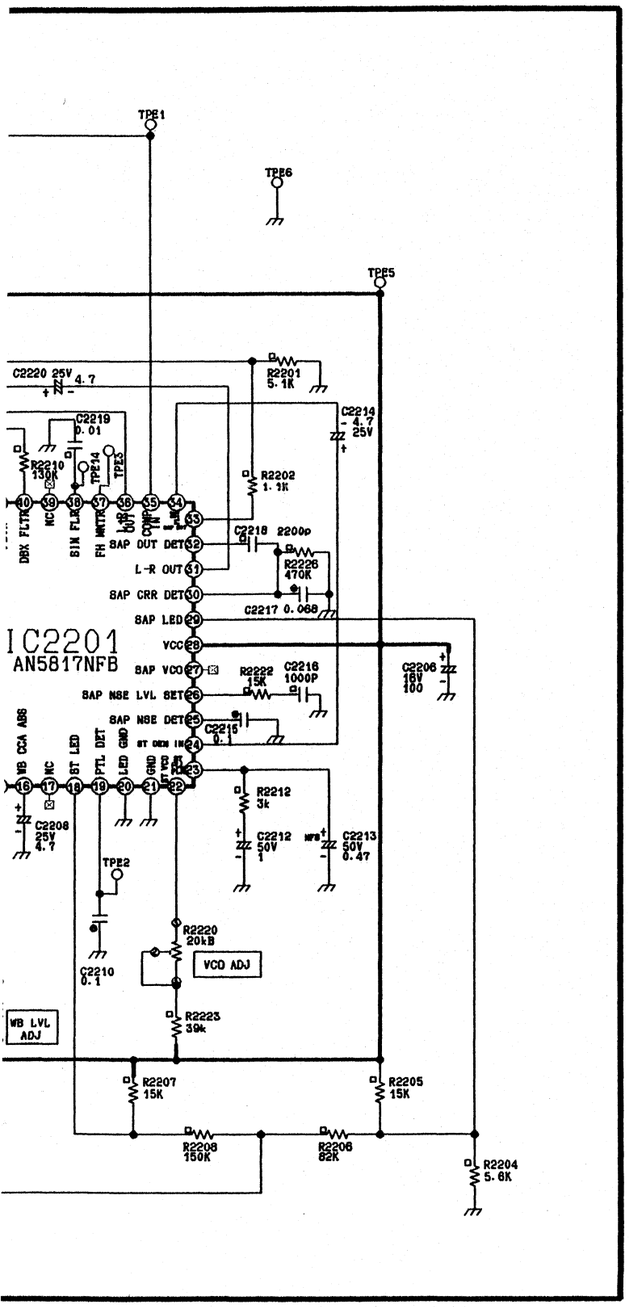
Z–Board



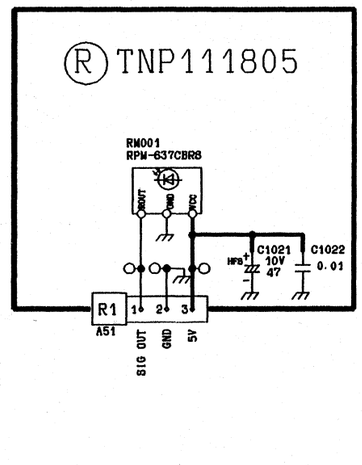
S–Board Schematics (All Models)

ıatics (All Models)

l Models)



R–Board Schematics (All Models)



Voltage Chart – E–Board
(All Models)

Integrated Circuits (ICs)

IC2201							
1	2.5	12	0.4	23	2.3	34	1.8
2	2.5	13	2.6	24	2.2	35	2.2
3	0	14	1.8	25	3.1	36	1.4
4	0	15	1.4	26	3.2	37	2.2
5	2.1	16	2.7	27	0.1	38	2.2
6	2.2	17	0	28	4.1	39	0
7	2.3	18	4.2	29	1.1	40	1.2
8	1.4	19	2.3	30	2.3	41	0
9	2.2	20	0	31	2.0	42	2.2
10	1.1	21	0	32	0.3	43	2.3
11	2.5	22	3.4	33	2.9	44	2.2

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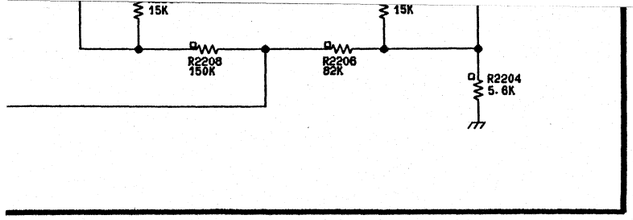

1	2.5	12	0.4	23	2.3	34	1.8
2	2.5	13	2.6	24	2.2	35	2.2
3	0	14	1.8	25	3.1	36	1.4
4	0	15	1.4	26	3.2	37	2.2
5	2.1	16	2.7	27	0.1	38	2.2
6	2.2	17	0	28	4.1	39	0
7	2.3	18	4.2	29	1.1	40	1.2
8	1.4	19	2.3	30	2.3	41	0
9	2.2	20	0	31	2.0	42	2.2
10	1.1	21	0	32	0.3	43	2.3
11	2.5	22	3.4	33	2.9	44	2.2

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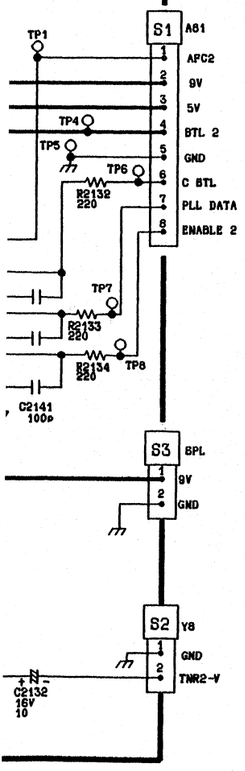
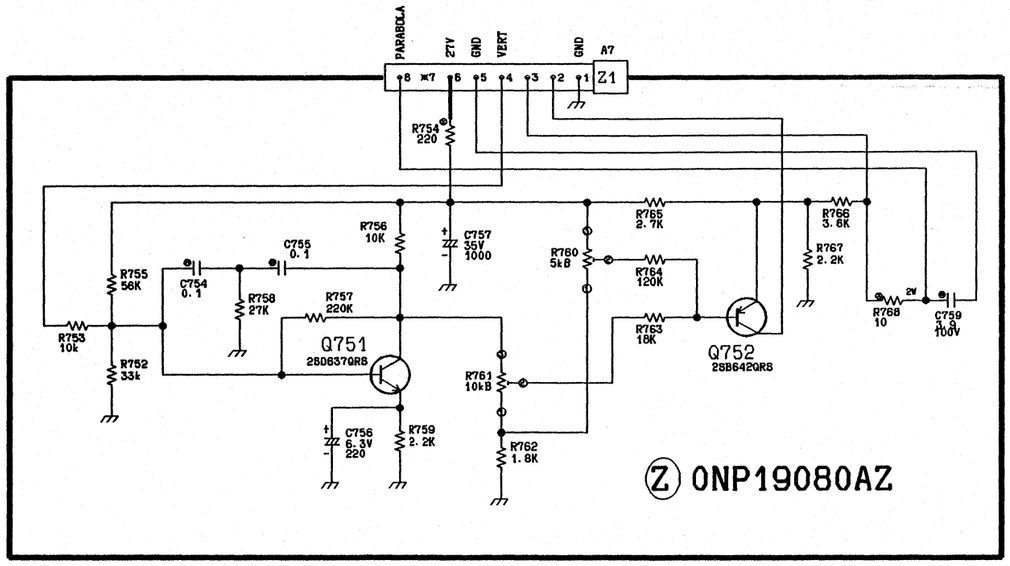


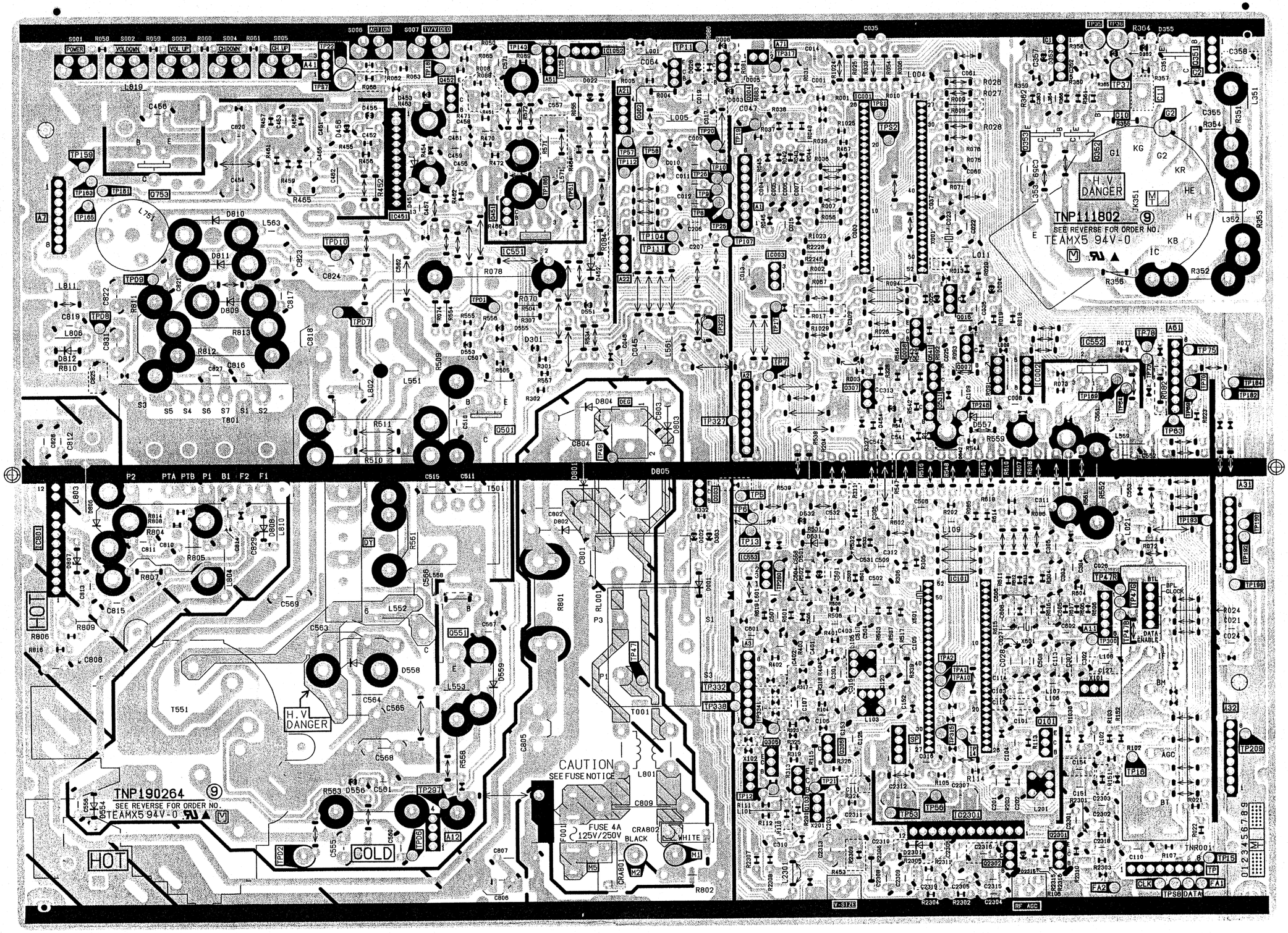
Z–Board Schematics (31” Models only)



Voltage Chart – Z–Board
(For 31” Models Only)

Transistors			
Ref.	**b**	**c**	**e**
Q751	2.9	9.2	2.4
Q752	9.0	0.6	9.6

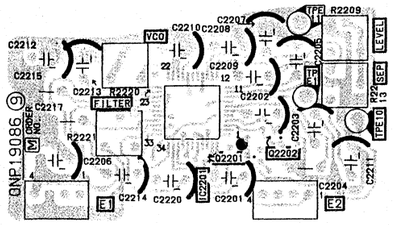
A–Board TNP190264



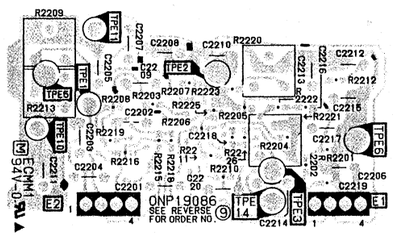
C–B

Board Layouts (All Models)

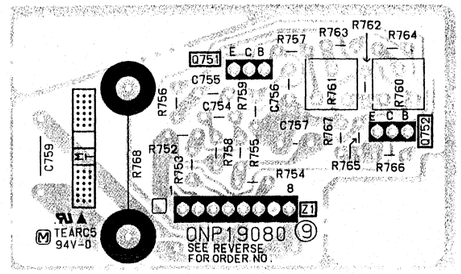
E–Board 0NP19086 (Top side)



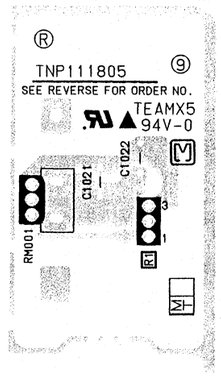
E–Board 0NP19086 (Bottom side)



Z–Board 0NP19080 (31" Models only)

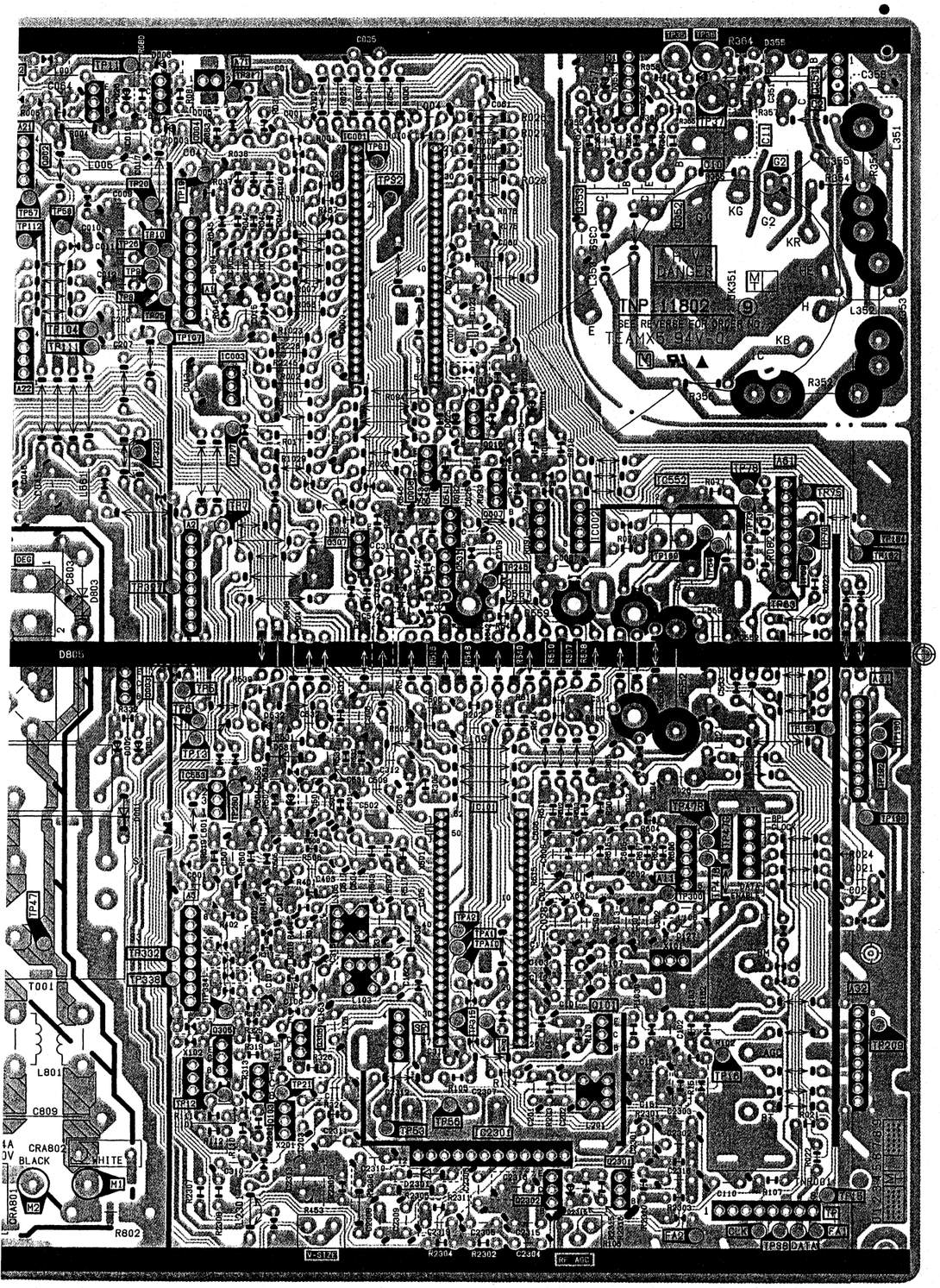


R–Board TNP111805

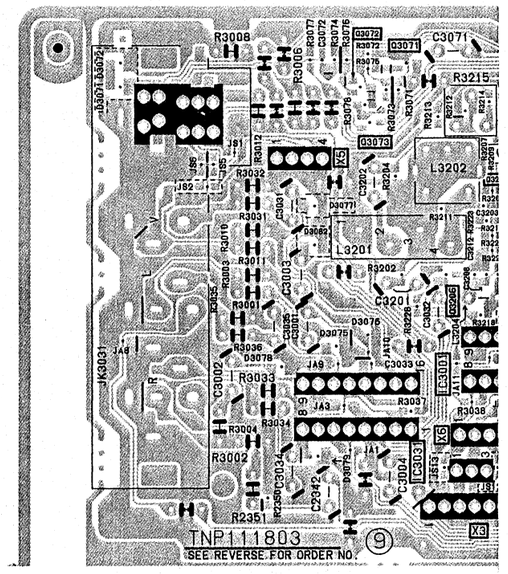


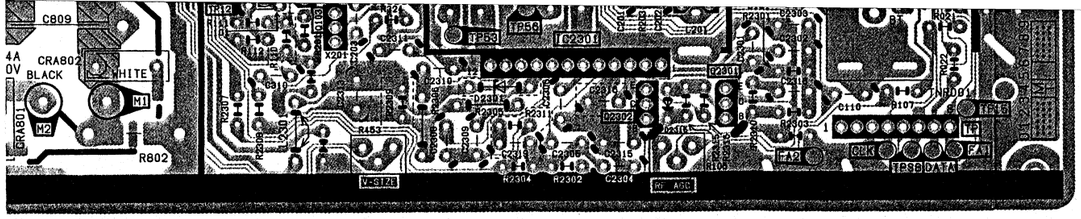
Board Layouts (All Models)

ard TNP190264

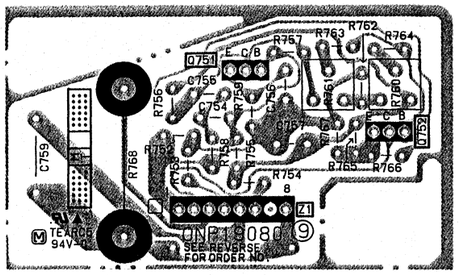


C–Board TNP111802

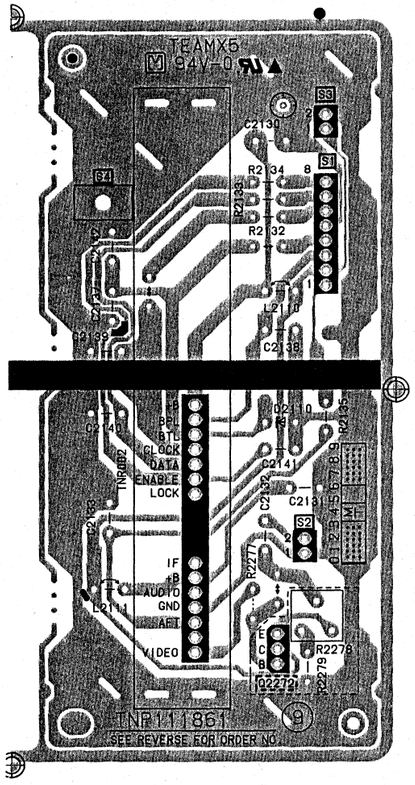




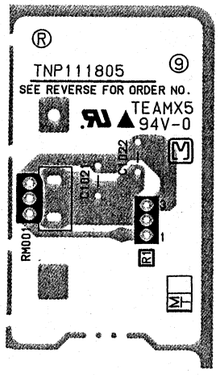
Z–Board 0NP19080 (31” Models only)

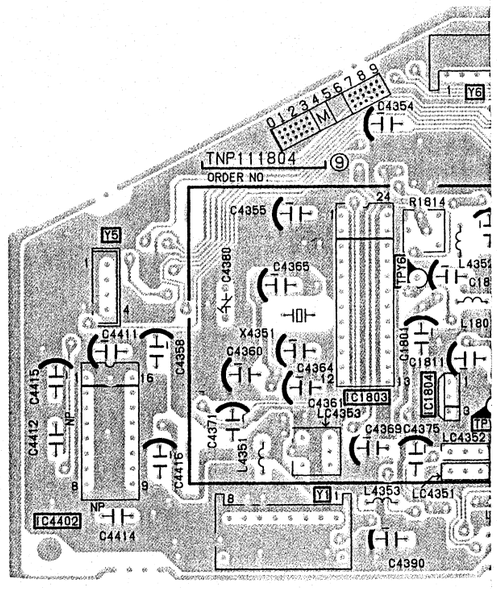


S–Board TNP111861



R–Board TNP111805

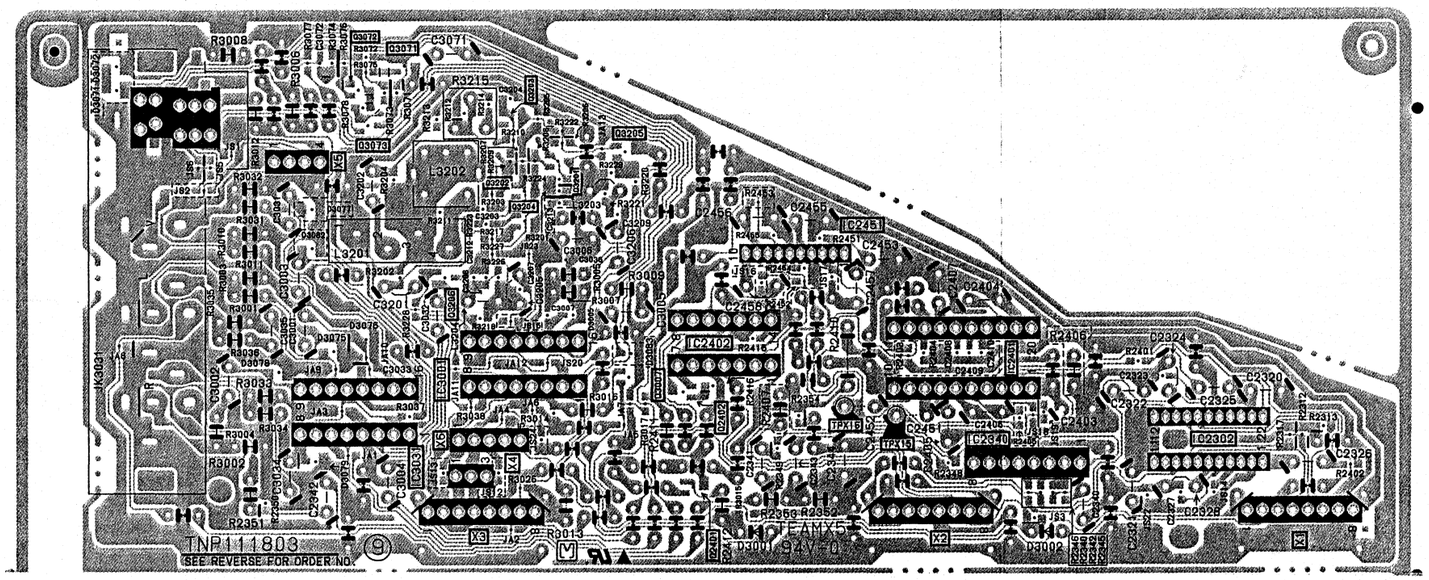




(Top side)

02

X–Board TNP111803



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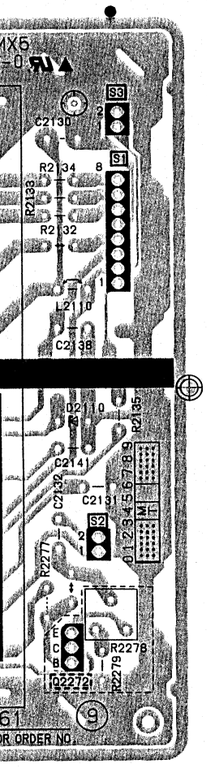
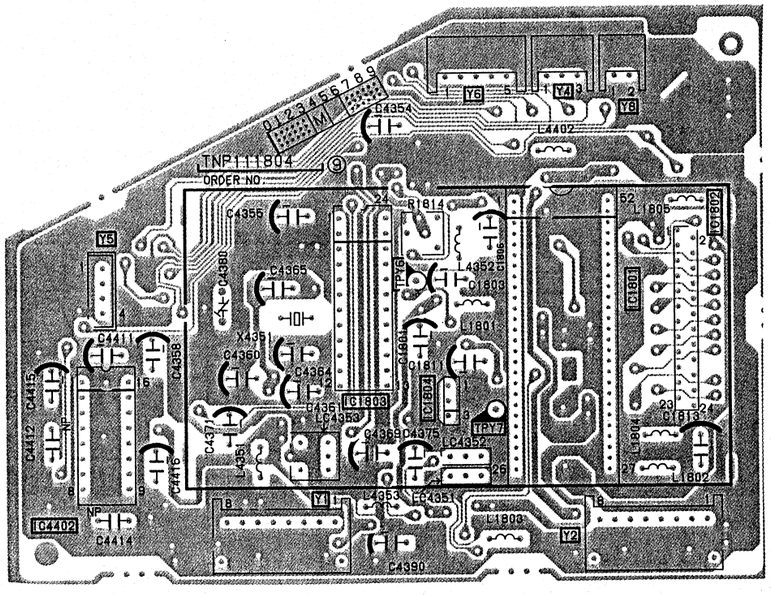
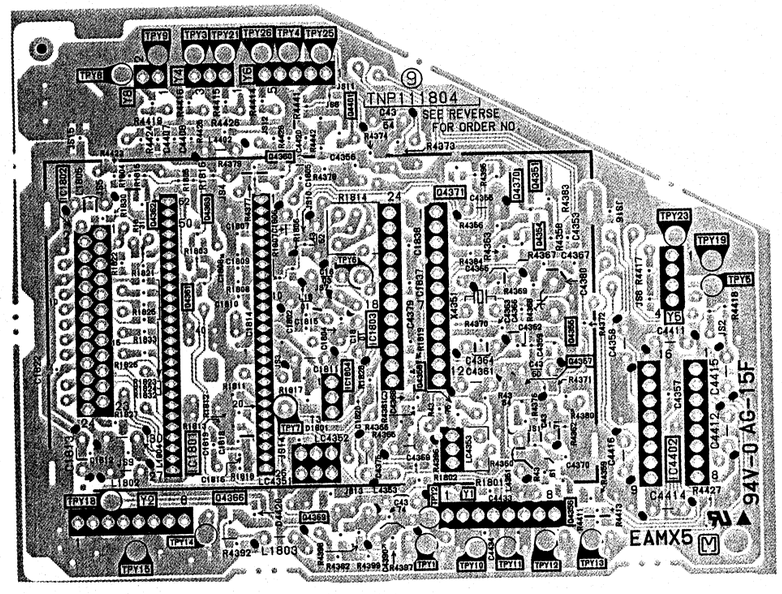
TNP111861



Y–Board TNP111804



(Top side)



(Bottom Side)